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DIVERTICULA AND DUPLICATURE OF THE DUODENUM[1]

WITH REFERENCE TO THE IMPORTANCE OF CHOLECYSTITIS IN THE PRODUCTION OF SYMPTOMS

BY JOSEPH W. LARIMORE, M.D., AND EVARTS A. GRAHAM, M.D., F.A.C.S.
ST. LOUIS, MISSOURI

DIVERTICULA of the duodenum present a particularly difficult clinical problem. A large majority of these are clinically silent, and are only casual findings. Others present difficulties because of association with concurrent upper abdominal disease. Indication for surgical interference depends upon the solution of the clinical question as to the origin of symptoms in a duodenal diverticulum or in such coincident disease. The association of ulcer with acquired diverticula is emphasized in many reports. Cases reported in this paper show cholecystitis to be the source of symptoms. That the diverticula may be the site of major pathology is also shown by many case reports. Davis (7), Baldwin (2), Wilkie (27), and Fisher (9) report cases causing death. Cancer primarily involving a diverticulum of the duodenum is reported by Morrison and Feldman (20). Gangrenous diverticulitis is reported by Huddy (13). Hunt and Herbst (14) found, at operation, a fistulous connection between the gall bladder and a false diverticulum of the duodenum; gall stones had entered the latter and were unable to escape because the stoma of the diverticulum was too small.

The literature of duodenal diverticula is now relatively extensive. From the first report by Chomel (6) in 1710, to 1910 the condition was discovered post mortem, or unexpectedly at laparotomy, and was considered rare. Between 1910 and 1915 the literature was concerned chiefly with X-ray demonstrations of these diverticula. During this period and since, the incidence of their discovery has increased and they have become an important clinical problem. The first operation on a duodenal diverticulum previously diagnosed by X-ray was by Forssell (10) in 1915 and from this time the literature is concerned chiefly with the surgical treatment. Andrews (1) gives a comprehensive review of the literature prior to 1921. Case (5) reviews the roentgenological reports to April, 1920. Hartung (12) recently reviewed the literature generally and reports the clinical and roentgenoscopical findings in 7 cases.

The incidence of occurrence is given in reports from various sources as, 7 per cent (Linsmaayer, 18); 3.8 per cent (Spriggs, 26); 3 per cent (Buschi, 4); 2 per cent (Case, 5); and 1.2 per cent (Andrews, 1). In a series of 3,446 cases having complete gastro-intestinal fluoroscopic and serial film studies made by one of us (J. W. L.), diverticula of the alimentary tract have been seen in 105 cases: 9 of the œsophagus (0.26 per cent); 3 of the stomach (0.09 per cent); 19 of the duodenum (0.5 per cent); 3 of the jejunum (0.09 per cent); and 71 of the colon (2 per cent). Bell (3) quotes

[1] From the Departments of Medicine and Surgery, Washington University School of Medicine and Barnes Hospital.

Fig. 1. A small pocket is evident on the medial side of the proximal second duodenum at the site of the ampulla of Vater, which it is considered to be. There was no prolonged retention.

Fig. 2. A small pocket is evident on the medial side of the proximal second duodenum at or near the site of the ampulla of Vater, but with greater distance from the duodenal lumen than that seen in Figure 1. The insert shows the retention of barium at 6 hours.

Baldwin's (2) statistics of frequency at the different levels for 67 collected cases and adds 11 cases: near the pylorus, 5; at the minor papilla, 10; near the major papilla, 13; at the major papilla, 36; in the third part, 14. Spriggs (26) gives the position in 57 cases as 11 in the first part, 41 in the second part, 2 in both the first and the second parts, and 3 in the third part. Nagel (22) reports from the Mayo Clinic an incidence of 2.2 per cent of congenital diverticula found at autopsy. These had given no symptoms. Nineteen acquired diverticula verified at operation are reported; 14 were associated with duodenal ulcer and 3 with gall-bladder disease. All were in the first portion. Downes (8) reported 4 cases, the diverticula being situated in every case in the third portion, at the duodenojejunal angle. Robineau and Gally (25) reported 10 cases, 7 of which had diverticula in the third portion (pars inferior) of the duodenum, three in the second portion and one in the first portion.

Duodenal diverticula have been classified as congenital and acquired, and have been considered as mostly acquired because found chiefly in the latter half of life. They are subdivided into the true and the false, the former showing all layers of the intestine, and the latter lacking the muscular layer. Buschi (4) gives 8 excellent reasons for considering these diverticula congenital. These reasons are quoted and emphasized by Moore (19). Pathological studies have shown definitely an acquired variety, usually associated with other primary pathological conditions, in the majority of cases with duodenal ulcer. Judd (16) asserts that "in most instances it (diverticulum of the duodenum) is acquired and is produced by the contracting scar of ulcer." Bell (3) in 1921 reports 2 cases found at autopsy and remarks that "in most instances diverticula of the duodenum were found at

Fig. 3. A diverticular pocket created in right side of duodenal bulb by deformity resulting from an ulcer.

Fig. 4. A penetrating pocket of a duodenal ulcer and not a diverticulum.

necropsy and had no direct relation with the cause of death." He concludes that his cases were of the acquired type occurring at points in the musculature where the vessels penetrated. A large variety of etiological factors are suggested: congenital defects such as weakness where vessels or ducts enter or pierce the wall; anomalous buds analogous to the fetal liver and pancreatic buds; trauma; venous congestion; intraluminal pressure; ulcer; inflammation; fatty degeneration of the muscularis; traction on the wall actuated by ptosis or by the mesenteric vessels.

The X-ray demonstration of these diverticula depends upon the appearance in the vicinity of the duodenum of an abnormal side-pocket which can be seen to fill and empty from the duodenum. Often this shows an air bubble. Films may demonstrate these conclusively and stereoscopic films have been of assistance. Fluoroscopy is in most cases necessary because a large orifice may allow prompt emptying, the horizontal portion of the stomach may obscure the picture, and redundant sacculations may be demonstrated as such by palpation. The majority of these diverticula are of the superior and descending portions and lie within the circle of the duodenum. A diverticulum to the right of the duodenum even in a high position is jejunal in origin. The roentgenological differentiation of congenital, acquired, and pseudo-diverticula cannot be conclusive. A gall stone may give a picture suggestive of a diverticulum if observed only in association with the barium meal. Independent examination will clarify the picture. Association of ulcer will give strong presumption for the acquired type and for a diverticulitis. Prolonged retention by the diverticulum favors the possibility of diverticulitis.

Another type of diverticulum has been encountered in 2 of the cases here reported. This is a pseudo-diverticulum which is an actual side-pocket to the duodenal lumen. It is by-passed by the duodenal stream and shows prolonged retention. There is no defect in the wall of the duodenum and these pockets are extreme redundancies having fixed topography. Differentiation of this type can be fully made only at operation. This type of diverticulum corresponds to Wilkie's (27) duplicature of the duodenal

Fig. 5. The anastomosis of the gall bladder to the duodenum as shown by barium entering the gall bladder from the duodenum. The anastomosis was made when the ampulla of Vater was resected for a small early carcinoma.

Fig. 6. The calcified contents of the gall bladder, which cannot be conclusively differentiated from a barium-filled diverticulum without observation independent of barium.

wall, but is more marked than that which he described. He says: "On closer inspection the doubling-in involves all the coats of the duodenum, and the contiguous parts of the outer muscular coat at the indented area are bound together by loose fibrous tissue. The duodenal wall appears to be redundant and altogether too large for its enveloping sheath." No other mention of this duodenal redundancy has been found.

A variety of factors must be considered in determining the clinical pathological activity of these diverticula. These factors may be grouped under two heads as inflammatory and mechanical. Diverticulitis is the rule in the acquired type associated with ulcer. These are usually in the first or proximal second portions. In all diverticula there may be a more ready entrance than egress due to the small size of the stoma and to its position as above, below, or at the side of the cavity, and also because of the positive intraluminal pressure upon the stoma, which, even in a true diverticulum having a muscularis, could hardly be equaled from within. Inflammation may occur as the sequence of independent upper alimentary conditions such as achlorhydria, duodenitis, gastritis, or cholecystitis.

There is no characteristic clinical picture of duodenal diverticulitis or of other complication in these abnormalities. The X-ray discovery of diverticula of the duodenum may have no other than anatomical interest. Other findings determine their clinical significance and chief among these is an exhaustive elimination of other independent upper abdominal pathology. Ulcer associated should give a clear indication for surgical care of both the ulcer and the diverticulum. This association has been emphasized in case reports by Jones (15), Murchison (21), and Penhallow (24). Symptoms, when present, are not pathognomonic nor characteristic. Judd (16) thinks the pain is sometimes similar to that of ulcer, but is not relieved by food. Symptoms are

Fig. 7. A large diverticulum lying within the circle of the duodenum, showing a fluid level, and air bubble. This diverticulum appeared to fill from the third portion. The insert shows its retention at 6 hours.

often similar to those of gall bladder disease and may be strikingly of that type with pain and jaundice. Lewis (17) reports such a case operated upon with the probable diagnosis of gall stones and a normal gall bladder was found. A diverticulum was discovered and invaginated with relief for the patient. Oehnell (23) summarizes the clinical picture of 34 cases. Ulcer was associated with 6, colitis with 5, pancreatitis with 2, and cholecystitis with only 1. Pain was prominent in 85 per cent with local tenderness in 29 per cent. Acid eructation and vomiting occurred in 44 per cent. The X-ray showed associated gastric and duodenal motor disturbance in 45 per cent, and retention by the diverticulum in 76 per cent. Since other right upper quadrant disease must be eliminated before a diverticulum as the source of symptoms can be evaluated, cholecystography by the method of Graham, Cole, and Copher (11) is an essential procedure.

Fig. 8. A large diverticulum showing retention at 6 hours, which persisted beyond 24 hours. This was definitely of origin from the proximal jejunum.

CASE 1. A female, aged 63 years, widow, entered Barnes Hospital complaining of periods of vomiting and diarrhœa during the previous 10 years. Vomiting usually occurred immediately after eating, and there was frequently abdominal pain following meals described as if "food stuck there." This was associated with heart burn and bad taste. The patient said there was "gas and distention" always after meals. These symptoms were especially prone to follow heavy meals. The bowels were alternately constipated and loose. Baking soda, often taken for burning, would cause diarrhœa. These symptoms had continued without notable variations during the 10 years. During the past year, the patient lost weight from 145 pounds to 125 pounds. Her physical examination was not notable for other than very slight tenderness in the epigastrium. The urinalysis was normal. There was an absence of occult blood in the stool, which was otherwise not notable. The gastric analysis showed an achlorhydria. Blood study showed red blood cells, 4,810,000; white blood cells, 9,250 of which the differential was normal. The patient was usually very comfortable in bed in the hospital with a light diet, having no vomiting, diarrhœa, or epigastric distress. At home, in the interval between her examination and her re-admission for operation, she had a return of all symptoms. Hydrochloric acid by mouth gave no relief. The X-ray showed a diverticulum of the duodenum in the distal third portion just proximal to the liga-

Fig. 9. The second duodenum is here atonic and retentive and appears as a diverticulum. Fluoroscopic observation easily differentiated.

Fig. 10. The redundancy of the duodenum was associated with pericholecystitis. Cholecystectomy relieved the associated symptoms.

ment of Treitz. This diverticulum showed a large air bubble; it filled partially with each passing of the barium stream and immediately almost completely drained. The duodenum, proximally, showed a pendulum motion, very marked and striking, and often accomplished reflux filling of the cap and slight return into the stomach. There was no associated colonic motor delay. The cholecystogram showed a normal gall bladder shadow.

Operation (*E.A.G.*). "There was a diverticulum extending upward from the duodenum about as large as two thumbs. In order to expose this properly it was necessary to cut a part of the ligament of Treitz. The wall of the diverticulum seemed to consist entirely of mucous membrane and serosa. The muscle seemed to divide and close around the diverticulum. The diverticulum was turned into the duodenum with a purse-string suture of catgut. The gall bladder seemed normal at operation."

Fig. 11 (left). The redundancy of the proximal duodenum was associated with pain and chronic dyspepsia. The progressive nature of this deformity is shown by the insert which shows the duodenum 18 months previously. Operation was not performed and cholecystography was not yet perfected.

Fig. 12. The diverticulum described in Case 1. It is shown as at operation in Figure 13.

Fig. 13. The diverticulum in Case 1 as it appeared at operation.

Fig. 14. The pseudo-diverticula in Case 2 showing retention beyond 6 hours as shown in the insert. The cholecystogram showed a pathological gall bladder. Operation showed a duodenal redundancy and folding with fixed topography explaining the diverticular pocket.

The postoperative course was stormy and the patient died on the fourth day of acute general peritonitis. A partial autopsy showed no evidence of leakage anywhere. The invaginated diverticulum was still in place, and the purse-string suture of catgut was holding it well with complete obliteration of the neck of the diverticulum. A pure culture of hæmolytic streptococcus was obtained from the pus.

CASE 2. A male, aged 57 years, married, occupation a tobacco worker, was admitted to Barnes Hospital complaining of loss of appetite and severe heartburn. The present illness had begun 9 years previously when he noticed a lump in his stomach, which has now disappeared, accompanied by distress in the epigastrium and distention. He was nauseated, and vomited at intervals without especial association. The symptoms have been more constant during the last 3 years with a great deal of pressure in the epigastrium, increased after exertion, and radiation of this discomfort upward over the precordium. This is described as being a hot and burning sensation, also worse after exercise. This is entirely unrelated to eating. The bowels had normal daily action. There were no dietary discriminations. Weight was maintained at 120 pounds. The patient was easily exhausted and his work had been limited because of the abdominal distress. He chews tobacco excessively. Past history showed acute articular rheumatism 10 years previously, and gonorrhœa 40

Fig. 15. The pseudo-diverticula as observed postoperatively in Case 2, the same as in Figure 14. The insert shows retention at 6 hours. All symptoms were relieved by cholecystectomy.

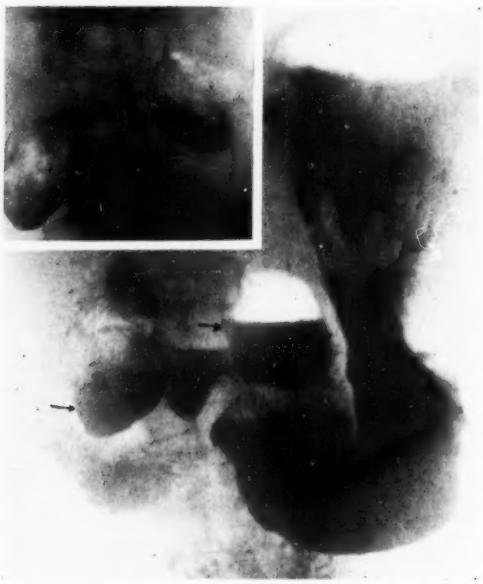

Fig. 16. The pseudo-diverticula in Case 3 showing retention at 6 hours (insert) which persisted beyond 24 hours. Cholecystography was not developed at the time of this case. At operation redundancy of the duodenum was demonstrated to form these pockets. Cholecystectomy relieved all symptoms. Postoperative roentgenology showed persisting similar pockets, slightly less retentive.

years previously with resulting urethral stricture. Physical examination showed undernutrition of the senile type, general physique was somewhat frail. The temperature was normal. The pulse was 80. The weight was 117½ pounds. General physical examination was not otherwise notable. Laboratory examination showed a normal urinalysis; an absence of occult blood or other notable findings in the stool; 4,020,000 red blood cells, 5,000 white blood cells with a normal differential count; a negative blood Wassermann; gastric analysis with hydrochloric acid deficiency of 20 in the fasting contents of which the microscopic examination was not notable; and the test meal at 45 minutes showed free hydrochloric acid of 40. Gastro-intestinal X-ray examination showed a diverticulum occurring to the left of the proximal second duodenum and apparently filling of that portion. In stereoscopic films it seemed to be directed posteriorly. It was retentive of barium beyond 6 hours. There was in association multiple diverticulosis of the colon involving the distal transverse colon, descending colon and the sigmoid colon. The distal sigmoid colon at the rectosigmoid junction was peculiarly free, this portion being abnormally patulous. This patient was examined by the method of cholecystography which showed a pathological gall bladder having atypical position and shape.

Operation (*E.A.G.*). "An upper right rectus incision was made and the duodenum carefully exposed for a distance of about 9 inches from the pylorus. No evidence of ulcer or of actual diverticulum was found, but there was an enlarged fold of duodenum about 5 inches from the pylorus which was bound over to another part of the intestine somewhat like a diverticulum. It seemed also as if some barium could be seen shining through the wall at this place. The gall bladder had thin walls but was adherent to the omentum and the ampulla was adherent by thin, filmy adhesions to the duodenum. The liver had a good deal of fibrous tissue in its capsule. All of the upper abdominal organs were ptosed somewhat. The fold of duodenum above described was merely freed and nothing further was done to it. It did not seem advisable to invert it and turn it in like a diverticulum because it was not a real diverticulum. The appendix was removed in the usual way and seemed to give some evidence of chronic trouble. The gall bladder was also removed from below upward. A piece of liver was removed for microscopic examination. A small rubber dam drain was inserted, and the wound closed in layers. Microscopical diagnosis: chronic cholecystitis: chronic hepatitis; chronic appendicitis."

A postoperative gastro-intestinal X-ray examination showed an accentuation of the redundant fold of the second portion of the duodenum beyond that of the pre-operative examination, but at this time the side pocket was more characteristic of a redundancy than of a real diverticulum. It did, however, retain barium beyond 24 hours. The patient was relieved of his symptoms.

CASE 3. A male, aged 59 years, married, was a carpenter. The present illness began 25 years previously, and approximately twice yearly an attack of severe epigastric pain had occurred. These attacks came on usually several hours after eating. The pain was very severe, of a cramping character with slight associated nausea and no vomiting. The attacks lasted several hours irrespective of measures used. Hypodermics were not used. Each attack was followed by a short period of severe diarrhœa. The bowels had generally shown a tendency to constipation. The last previous attack was in December, 1924. Physical examination showed a well nourished man. The liver was palpable two finger breadths below the costal margin. There was a right inguinal hernia, easily reducible. The urinalysis was normal. Blood study showed red blood cells 4,990,000, hæmoglobin 90 per cent, white blood cells 6,750 of which the differential was normal. The gastro-intestinal roentgenogram showed two diverticula of the duodenum, one of the proximal second portion and the other of the distal third portion, and there was an associated gastric motor insufficiency of slight degree, functional in character. These diverticula retained barium for 24 hours. There was an accompanying slight colonic motor delay. This patient was examined before the development of cholecystography.

Operation (*E. A. G.*). "The entire duodenum lent itself well to a good exposure and examination, but no diverticulum was found, although there were numerous adhesions between the gall bladder and the duodenum. The gall-bladder wall was thickened —cholecystectomy, appendectomy. It was believed that the distortion of the duodenum was produced by adhesions." Postoperative gastro-intestinal X-ray examination showed the pseudo-diverticula of the duodenum which were considered at the previous, pre-operative observations as true diverticula. They had similar capacity and topography, but did not show such prolonged retention as previously. This patient was seen at intervals after his operation. He had remained entirely well for 2 years after the operation when last seen. The symptoms of which he complained were obviously due to the chronic cholecystitis and not to the retention in the diverticulum-like redundancies of the duodenum.

SUMMARY

The X-ray findings of duodenal diverticula are presented as seen in various types. A pseudo-diverticulum is described as a necessary third classification in addition to the true and the false types. Such pseudo-diverticula are redundant duplications of the duodenum within its retroperitoneal sheath and have a fixed topography. They operate as diverticula. They are probably congenital in origin. Differentiation from the true or the false type cannot be made prior to operation or autopsy. Three operated cases are reported, one of a large false diverticulum and two of pseudo-diverticula. These last two cases had pathological gall bladders, the removal of which relieved all symptoms, although the duplicature or practical diverticular side-pockets of the duodenum persisted. Emphasis is given to consideration of the gall bladder in evaluating symptoms with which duodenal diverticula may be found associated. Cholecystography, by the method of Graham, Cole, and Copher, has made possible such adequate gall-bladder diagnosis and is an essential procedure in these cases.

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A STUDY OF THE MALIGNANT BREAST BY WHOLE SECTION AND KEY BLOCK SECTION METHODS[1]

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I VENTURE to present to you today certain thoughts regarding carcinoma of the breast—aspects of the disease which would seem to be revealed when the tissue affected is submitted to investigation by one or other of the whole section methods.

If this study has had one effect above all others, it is that it has impressed us with the value of whole section pathology with the importance of a bird's-eye view, so to speak, of the entire field in which pathological changes may be anticipated. I feel that too often we may say with Pope:[2]

"'Tis but a part we see and not a whole."

The method of cutting the windowpane block has its advantages, no doubt; it presents us with the picture of the hub of the pathological condition, but the spokes and the rim are equally vital to the life of the wheel, and it would seem that we sometimes forget what we may call the "peripheral pathology of disease."

MATERIAL AND METHODS

Fifty malignant breasts have been submitted to examination by the methods to be presently detailed, and we are indebted to many of our colleagues for the assistance they have so ungrudgingly given in affording material. In addition to the obviously pathological material, a number of presumably healthy breasts were examined in order to observe the changes of physiological states and to detect early pathological features.

The method of investigation requires a word of explanation.

The breast, together with its coverings, related fascia, and muscle, was fixed in Joré's-fluid immediately after removal. When fixation was complete the breast was cut in such a way that the center of the nipple and the center of the tumor lay in the same plane. Each half breast so obtained was then divided into a series of slices each measuring roughly 1 centimeter in thickness. The various slices, comprising one-half of the breast, were embedded in celloidin after the usual alcohol and ether preparation, and cut with a large sliding celloidin microtome. It was an easy matter to number the slices in serial order and to orient the upper and lower surfaces respectively by a simple mark.

The slices of the remaining half of the breast were investigated by the "key block" method. The "whole" celloidin section, while it affords an excellent general appreciation, lacks the finer cytological detail of a paraffin section, and therefore, if the eventual picture is to be complete in its ultimate detail, paraffin sections, stained if necessary with specific stains, must be available. The method we have followed has the advantage of simplicity.

The central surface of each slice of breast tissue is photographed to actual size or drawn in outline. The picture which constitutes the model is subdivided into a number of blocks or squares of suitable size, each block is numbered, and the corresponding slice of tissue is then divided into its component blocks according to the scheme in the outline of the key or plan, each tissue block being numbered according to the figure on the key. Care must be taken to orient each block in respect of its various surfaces and borders; otherwise confusion will arise. This may be conveniently done by embedding threads of different colors in each block so that the various surfaces and edges are defined. In this way, perfect orientation is secured.

With a series of whole celloidin sections on the one hand and a "key block" system of paraffin sections to afford the more intimate cytology of the opposite half of the breast, we have as complete a picture of the various pathological changes as it is possible probably

[2] Pope. Essay on Man. Epistle 1, line 60.

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October 25–29, 1926.

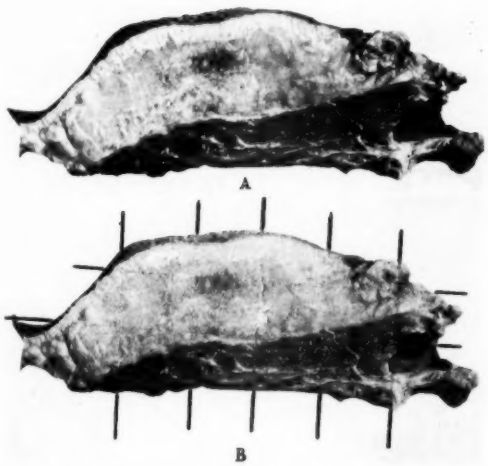

Fig. 1. Examination of a malignant breast by the "key block" method. A, A thin section of the tumor-bearing breast. B, The section is divided according to the plan shown in the photograph, and each numbered block is embedded and sectioned.

to obtain, a picture in which the entire breast area is brought under review. We must, however, make the confession (if confession it be) that we have not cut each and every block completely. We began the investigation with the best intentions, for it was our aim to stain, mount, and examine every tenth section, but, if the spirit was willing, the flesh was weak. Nevertheless, we have attempted to investigate each breast on the lines which we have described.

THE HISTOLOGICAL PICTURE

The study had not been long in being before it became evident that, if the true significance of the morbid is to be appreciated, it must be approached through the portals of a careful study of the normal. While this principle must necessarily hold good to some extent in all pathological problems, its importance is itensified in breast pathology, for we are dealing with an organ the physiological life of which witnesses and experiences a wealth of change, a continuous interaction between glandular and supporting structures, and a constant reproduction and adjustment of tissue which is amazing in its resource.

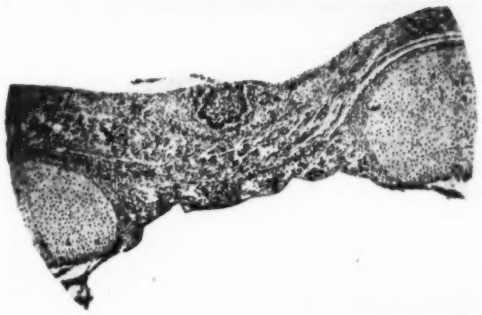

Fig. 2. Mammary area of embryo (16 centimeters). The formation of the epithelium invaginating cup is well shown. (× 15.)

THE DEVELOPMENT OF THE MAMMA

To make the picture a more complete one, I show you a section through the mammary area of a 16 centimeter embryo about the beginning of the third month of development, and you will see the process of downgrowth of the epithelium, which results in the formation of a cuplike invagination. Embryonic skin is composed of two layers, the superficial flattened in outline, several cells in depth, and constantly desquamating on the surface, obviously a product of the second deeper and more stable layer. This deeper stratum is a single layer of cubical cells, spheroidal in shape and provided with large nuclei containing abundant chromatin.

When the mammary invagination occurs, it is the deeper layer which is activated, the individual cells altering in shape from the original cubical into a more columnar-like arrangement, the nuclei collecting at the peripheral poles of the cells. Proliferation continues as it did before invagination occurred, and the center of the cup is filled with a collection of cells derived from the deeper columnar-like layer.

In the further development—the budding of solid epithelial cords into the surrounding mesoblastic tissues—it is the deeper layer of cells which plays the primary part in any fresh activity of growth. It is therefore apparent that to a most unusual degree a single type of cell is responsible for the development and structure of the mammary parenchyma.

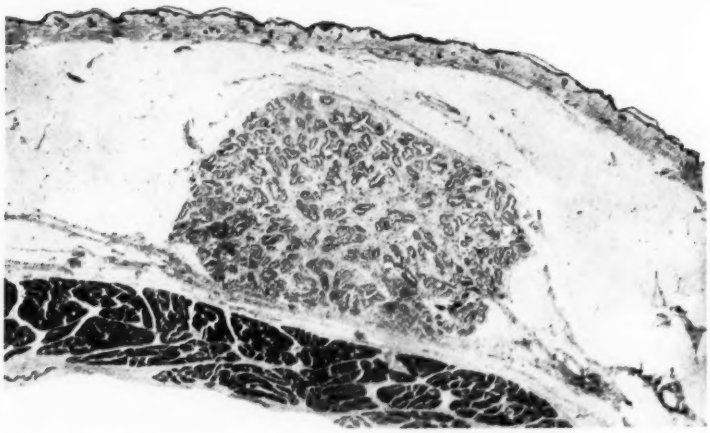

Fig. 3. Section through mammary area of child six months old. There is considerable tissue activity, and the section shows large numbers of new acini.

THE LATER GROWTH

I remind you that throughout the early months of postnatal life the breast exhibits a phase of considerable activity. I show you a section of the mammary region obtained from a child 6 months old. The solid epithelial cords of the embryonic state are now canalized and lined with one or two layers of cubico-columnar cells. Cell proliferation is proceeding, and the lumina are filled with proliferated and degenerated cells. A greenish-golden pigment is scattered in droplets throughout the cells or collected into larger globules; the pigment is evidently the forerunner of colostrum. A point of significance in view of future changes is the comparatively small amount of stroma; the gland is a mass collection of small ducts overshadowing in proportion the comparatively scanty amount of stroma or connective tissue element. This phase, however, is a passing one, for by the end of the first year the parenchyma activity has subsided, and the organ consists of a group of simple ducts, twelve to fifteen in number, converging to the nipple, and supported by a matrix of fibrous connective tissue.

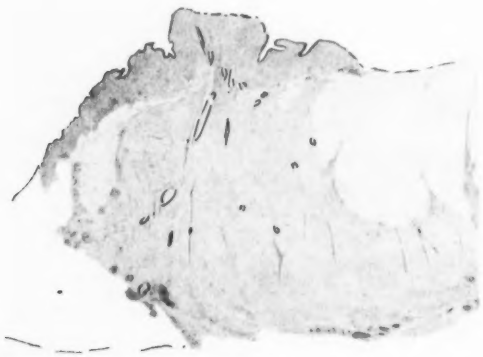

Fig. 4. The virginal breast (intermenstrual stage). The corpus mammæ is mainly stroma supporting ducts; there is virtually no acinar tissue.

With the advent of puberty, we find a further distinct and intense stimulus of the parenchyma portion of the gland. From the original ducts lateral branches appear by a process of budding and canalization, so that in a gland in which the stroma hitherto predominated to an overwhelming extent we now find a corresponding increase of the ducto-acinar tissue.

The puberty change, like that which occurs at birth, is a passing one, and the breast settles down into a phase of comparative stability, which is interrupted to a minor degree, it is true, by the occurrence of each menstrual period. The postpuberty

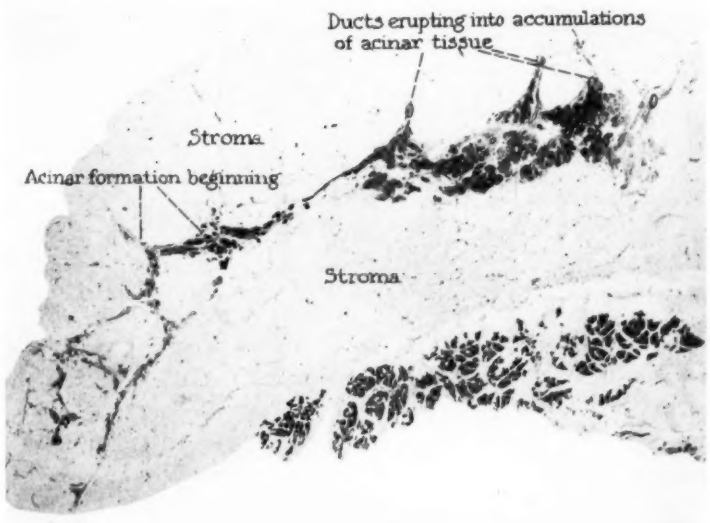

Fig. 5. Virginal breast (menstrual stage). There is an intense formation of acinar tissue from the terminal portions of certain ducts.

phase is conveniently described as the period of "the virginal breast," and much interest attaches to the cycle of structural changes which distinguish it.

THE VIRGINAL BREAST

Rosenberg,[1] in a paper published in 1922, stated that the virginal breast of the intermenstrual period contains virtually no acini, but consists of ducts lined with epithelium and supported by a fibrous stroma. Coincident with ovulation and the formation of the corpus luteum, budding outgrowths appear in the wall of the ducts, and a rapid multiplication of epithelial cells takes place, giving rise to large numbers of small lobules of glandular tissue which are virtually outgrowths of duct lining epithelium. When impregnation does not occur, and when the corpus luteum retrogresses, the lobules break up so that during the intermenstrual period they have virtually disappeared.

Polano[2] and Sebening[3] have worked at similar aspects of the question, but, while Rosenberg's material was entirely postmortem, theirs was derived from the living subject. In general they agree with Rosenberg's findings except that they deny that the postmenstrual retrogression is so complete as he states it to be.

The recent work of Dieckmann[4] suggests that the absence of acini in the virginal breast which Rosenberg described may have a developmental or even a pathological explanation, for he showed that as a whole the patients in whom Rosenberg found no acini were younger than those in whom acini were present. Dieckmann regards the nonacinar breast as representing an infantile type which had not yet developed acini, and his findings are more in agreement with those of Polano and Sebening that postmenstrual retrogression is never complete. Dieckmann has described in detail the cellular changes which distinguish or characterize the menstrual period—an œdema or vacuolation (Lappchenoedem) of the outer layer of the two-celled layer of the acinar epithelium and a later œdema of the interlobular stroma.

[1] Rosenberg. Ueber menstruelle durch das Corpus Luteum bedingte Mammaveraenderungen. Frankfurter Ztschr. f. Pathol., 1922, xxvii.

[2] Polano. Ztschr. f. Geburtsh. u. Gynaek, 1924, lxxxvii, 363.

[3] Sebening. Arch. f. klin. Chir., 1925, cxxxiv, 464.

[4] Dieckmann. Arch. f. path. Anat., etc., 1925, cclvi, 321.

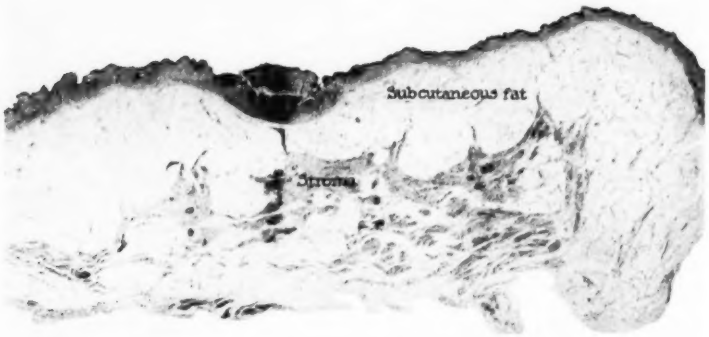

Fig. 6. Senile breast. The breast stroma is condensed; there is a comparatively small amount of acinar tissue; the ducts are moderately dilated.

Whatever minor differences there may be between the findings of these individual investigators, the consensus of their work bears evidence to the repeated progression and retrogression, to the instability, in fact, which distinguishes mammary tissue of the virginal period, for the breast undergoes changes with each monthly cycle, and, though there may not be as yet uniformity of opinion regarding their precise nature, it is agreed that the changes form a part of the general cyclical phases of sexual maturity.

It is further evident that it is the parenchymal tissue which responds to the stimulus which the sex gland hormone is supposed to excite, and one of the most impressive features of these various changes is the adaptability of this parenchyma, its power of proliferation in response to stimulus, its ability to retrogress when the demand has passed. It is difficult to suggest a parallel in any other portion of the body tissue.

Thus it is that the process of progression and retrogression is continued, as though in preparation for the highest goal of its functional life, the lactating breast, a state in which the cellular activity both in degree and duration transcends all that has gone before.

THE SENILE BREAST

Subsequent to the menopausal phase the mammary tissue passes into a period of what may be termed terminal stability, a state in which the healthy proliferation of the parenchymatous element ceases to appear. The term "senile breast" has sometimes been applied to the tissue of this period, but the description is used not so much in respect of age as in relation to the condition of the breast tissue. The senile breast may be said to show three outstanding histological characteristics: the stroma preponderates markedly over the parenchyma, any small amount of acinar tissue which exists is wasted and atrophic, and (what is of particular significance in the view of many observers) there is an overgrowth of the "elastica" tissue in relation to ducts and acini. Cheatle[1] has described the precise arrangements of cells and supporting structures in relation to the ducts and acini. The smaller ducts are lined with a single or double layer of columnar-like cells, and these are continued with no appreciable change, unless it be a slightly more cubical shape, into the acini. The cells of both ducts and acini rest upon a delicate single layer of unstratified muscle fibers, a structure to which Bender first drew attention. A delicate basement membrane underlies the muscle layer, and then there exists a well-marked layer of fibrous tissue, to which Cheatle has given the name of "the intra-elastica." This layer is bounded by a thin layer of elastic tissue, the "elastica," a structure which surrounds the ducts, but which is not prolonged over the acinar wall. More superficially there is a layer of unstriated

[1] Cheatle, Sir. G. L. Brit. J. Surg., 1922-23, x, 436.

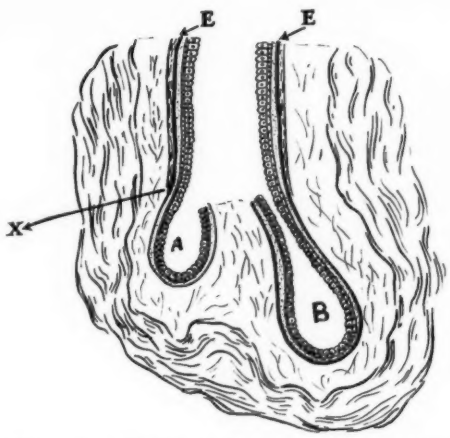

Fig. 7. The distribution of the elastica in relation to duct and acinus. A, The elastica has terminated before the acinus structure begins, B, The elastica is continued over the acinar outline. (Modified from Cheatle.)

muscle fiber, the distribution of which is limited to the wall of the duct. Each collection of acini in the related duct or ducts constituting a lobule is set in a groundwork of fibrous connective tissue, which is somewhat looser in structure than that constituting the bulk of the breast stroma. The absence of elastica over the acinar surfaces (which

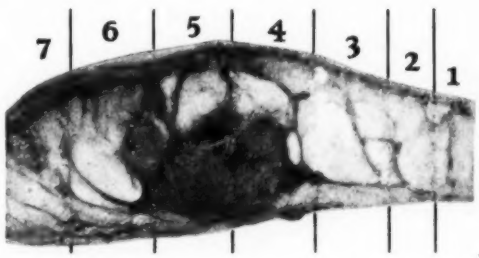

Fig. 9. Epithelioma of breast. A section of the tumor has been prepared for examination by the "key block" method.

are virtually the smaller duct cul-de-sacs) is explained by the incidence of functional activity and cell proliferation which characterize the region. It is obvious that the existence of an elastica covering in this situation would greatly limit the field of cell proliferation; in other words, would limit the formation of new acini.

In the senile type of breast special significance must attach to the reaction of the elastica. Berka,[1] publishing in 1911 the results of a detailed research into forty-six breasts and studying the relationship between the stroma and the glandular tissue, con-

[1] Berka. Frankfurter Ztschr. f. Path., 1911 viii. 203.

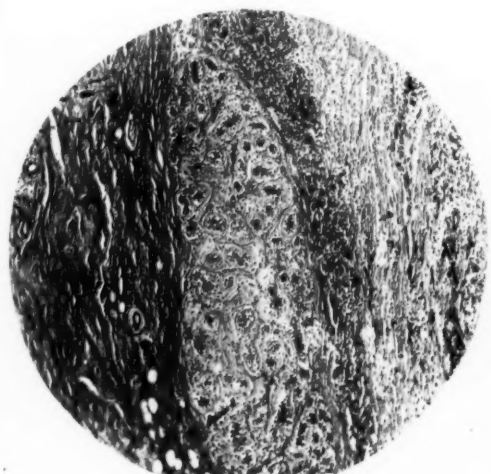

Fig. 8. Section of senile breast showing the development of elastica around the duct termination. (× 60.)

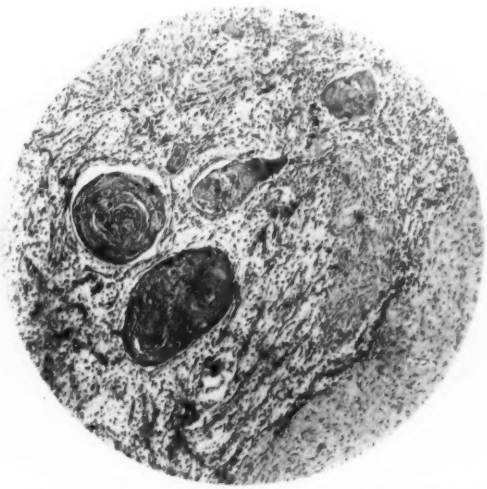

Fig. 10. Cell nest formation in epithelioma of the breast. (× 60.)

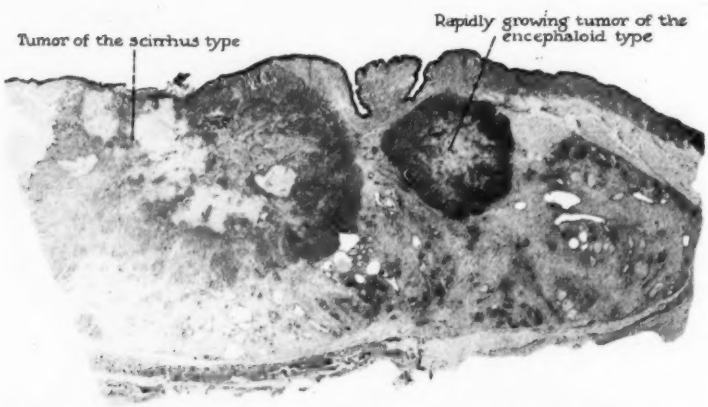

Fig. 11. To illustrate the fact that various types of tumor formation may occur in the same breast.

sidered that the elastic tissue ordinarily increased in amount with advancing years, and that, apart from the question of age, its increase is a mark of decreasing functional capacity of the organ. It is characteristic of the senile breast that not only is the elastic tissue increased in amount, but it is found to exist in situations in which it is not normally present, in the interacinar tissue and within the glandular lobules.

It is evident that after a certain age the formation of elastic tissue in breasts must be considered as a normal feature; indeed, it is possible that its absence may be a fact of some significance.

We have said that the term "senile" is employed not so much in respect of age as in relation to the state of the breast tissue, and we may add that, as far as statistical evidence can help us, the development of the senile breast is hastened by certain constitutional and clinical conditions—the absence over a prolonged period of the normal menstrual stimulus, as in prolonged amenorrhœa, the absence of the states of pregnancy and lactation, and possibly the overstimulus which is apt to result from repeated pregnancies.

We have attempted to outline the leading changes which characterize the physiological life of the breast, and the sequence we have recited is surely an interesting progress of events. The miraculous power of acinar development is an impressive feature; it characterizes the premenopausal period, and, because of the association of events, there would seem little doubt that this development arises secondary to the stimulus of a sexual gland hormone. With the advent of the menopause, hastened it may be by the abnormal clinical states we have mentioned, it would seem as though, the need for the development of new ducto-acinar tissue having passed, the duct terminations which remain are sealed up by the development of an elastica which, normally existing around the ducts, now extends over the acini and even enters the interacinar tissue.

With this impression, therefore, of the physiological breast and its associated conditions, let us notice certain of the impressions we have received from a study of the malignant breast.

THE TUMOR CLASSIFICATION

Many investigators have complained of the confusion and obvious redundancy which at present exist in connection with the terminology and classification of breast tumors. In a recent search of the literature we tabulated nineteen reported varieties of tumor formation, while Deaver and McFarland[1] in the course of a protest against this unsatis-

[1] Deaver, J. B., and McFarland, J. The Breast; Anomalies, Diseases and Treatment, p. 481.

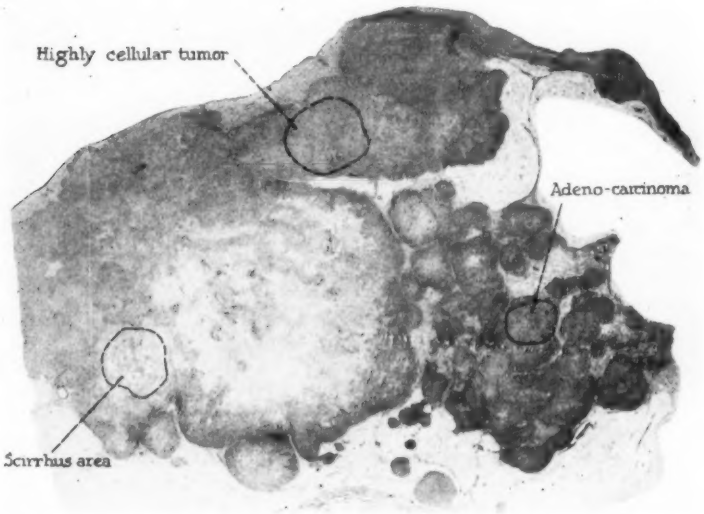

Fig. 12. Breast No. M1 showing different varieties of tumor. (Semi-diagrammatic.)

factory state of affairs record fifty-four different classifications of mammary tumors. Dr. Lane Claydon[1] in her recent report to the British Ministry of Health draws attention to the obvious anomaly, and in connection with the statistics which she elaborated she suggests that the cellular characteristics of the tumors permit of their classification into one or other of the three following groups: (a) spheroidal-celled carcinoma (mainly fibrous); (b) spheroidal-celled carcinoma (mainly cellular); (c) columnar-celled carcinoma. We welcome the simplicity of this arrangement, but it is scarcely sufficiently embracing.

I show you a celloidin whole section of Breast No. 440 obtained from a subject 52 years of age. Clinically there was a malignant tumor occupying the center of the breast. A history of a slight blood-stained discharge from the nipple suggested the proximity of the tumor to one or other of the larger ducts, but the growth was deeply situated and not related to the skin or the overlying nipple. The clinical characters of the tumor, in fact, were those of an ordinary mammary carcinoma.

[1] Lane Claydon. Cancer of the breast and its surgical treatment. Reports on Public Health and Medical Subjects. British Ministry of Health MO. 28, p. 43.

But let us see what the histological detail of the key block section reveals. In certain areas of the tumor (and this point illustrates the importance, in fact the necessity, of a more general examination), we find characteristic cell nest formation. This tumor is a squamous-celled epithelioma, developing evidently from epithelium in the termination of the larger ducts; a squamous-celled carcinoma must, therefore, be included in the simple category we outlined above.

But is any hard and fast classification dependent on the type of cell and the relationship of the fibrous tissue applicable to each individual breast? If we examine a series of whole breast sections we find that there is often no uniformity of structure throughout the extent of the growth. I show you a characteristic example of this truth. Breast No. 11 is the site of an extensive tumor formation. To the left of the nipple there is a large mass of disease, to the right of the nipple there is a smaller nodule. I believe that the tumor on the left was the original one, and that the swelling on the right arose secondarily, yet they are now very different in structure. A is a type of tumor which would be classified as a scirrhus carcinoma; B resembles the highly cellular tumor with only a trace of

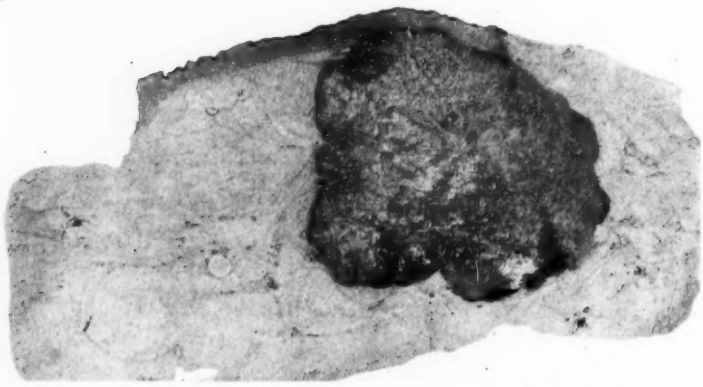

Fig. 13. Extensive tumor formation, yet showing wonderful localization.

fibrous tissue, the variety which is usually spoken of as encephaloid. Again Breast No. M.I., in part of its tissue, shows the structure of an adenocarcinoma, while a section taken 2 centimeters distant from this portion has the dense fibrous stroma of a scirrhus cancer.

At this stage I do not attempt to come to any conclusion as to which of these types represents the structure of the original tumor; rather am I anxious to show that in many breast tumors there is no uniformity of structure, and accordingly any classification which is based upon the cytological detail of a small section of the growth is apt to be misleading.

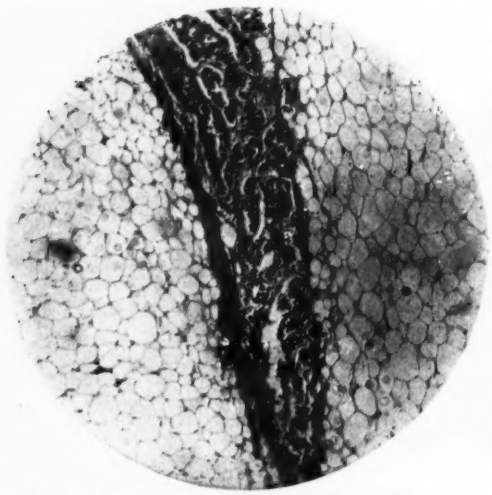

Fig. 14. Cancer-cell infiltration limited to one side of a fascial spur. (× 60.)

I am unwilling to enter into debate regarding the histogenesis of breast cancer, because, not being a pathologist, I am fully aware of my own limitations in this branch; none the less one of the reasons which prompted this investigation was a desire to throw some light on the obscure problem of the early development of breast carcinoma, and the cell tissue from which the tumor takes its origin.

Ewing,[1] in his recent volume on neoplastic diseases, classifies breast carcinoma on anatomical features into three groups: adenocarcinoma, arising chiefly in cysts of ducts or sweat glands; duct carcinoma, arising from the lining cells of the duct; acinar carcinoma, arising from the epithelium of the acini. These various types virtually include all the epithelial sources which the breast contains, but when this statement is analyzed and rearranged on a simpler basis it may be taken as meaning that tumor tissue originates from (1) the epithelium of ducts and acini, (2) the epithelium which lines the sweat glands.

Let us consider the second of these groups. Creighton, whose book on the *Physiology and Pathology of the Breast*, published in 1886, is a mine of useful and interesting information, showed that, while the breast as a whole

[1] Ewing, J. Neoplastic Disease, 1922, 508.

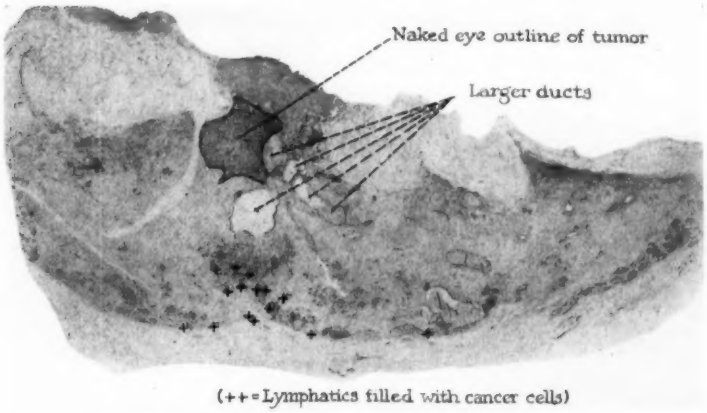

Fig. 15. Whole celloidin section of malignant breast, illustrating the distribution of lymphatic dissemination.

develops, certain parts may remain in a rudimentary state. This primitive breast tissue consists of tubules of a sweat gland type arranged in ill-formed whorls of a fetal or infantile pattern. In a later publication Creighton stated his belief that this tissue formed the sole origin from which breast carcinoma arose.

Von Saar[1] and Krompecher,[2] while not agreeing with the generality of Creighton's assertions, supported his view that tumors may originate from this source, and Ewing[3] stated: "Cancer does not develop from the ordinary normal secreting parenchyma or ducts of the breasts, but from redundant sweat glands not properly incorporated in the breast." It is obvious that Ewing must have modified his views since this was written.

It is evident, therefore, that there is a considerable body of recorded evidence that breast carcinoma may on occasion originate from nests of imperfectly developed mammary tissue. The term "sweat gland" is misleading; the epithelium is of a sweat gland type, but surely it is less confusing to speak of it as a fetal or infantile type of mammary epithelium.

There is no doubt that "rests" of this description occasionally form the center from which breast tumors develop. In this event the early tumor is isolated from the corpus mammæ and forms an independent swelling, usually superficial to the mamma. The percentage of these tumors is small, however; there were two in the present series, both early cases, and in both a distinctive clinical feature was the fact that the tumor was distinct from the corpus mammæ.

The epithelium which lines the ducts and acini remains the other available source. One asks oneself, is there any valid reason for attempting to distinguish between a duct and an acinar origin? The lining epithelium is a continuous structure, and, except in the squamous type of the terminal ducts, there is virtually no structural distinction between duct and acinar varieties. That there is a distinction, however, in respect of growth is evident. We have made repeated allusion to the faculty which the breast possesses of producing and regressing acinar tissue; this ability evidently centers in the epithelium which lines the terminations of the smaller ducts, for it is from these that new acini primarily develop. Judging by the degree of cell instability upon which this power must naturally depend, this is the region on which one's suspicions would fall if one argued upon a purely deductive basis.

There is a structural peculiarity which may be of importance in relation to this

[1] Von Saar. Ergebn. d. Chir. u. Orthop., 1910, 411.
[2] Krompecher. Verhandl. d. deutsch. Path. u. Gynaek., 1913, xvi, 365.
[3] J. Cancer Research, 1916, i, 385.

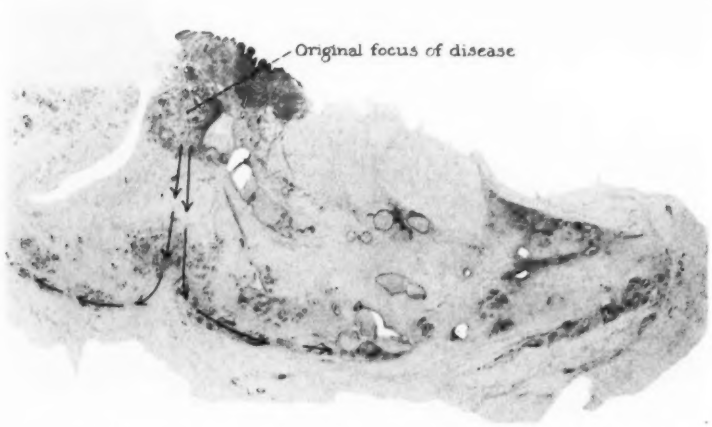

Fig. 16. Scheme of lymphatic dissemination in early central cancer, as shown by plotting out infected lymphatics.

question. It has been described how the zone of distribution of the elastica and its related tissue terminates before the acinar region is reached; it is only in the senile type of breast that the circumacinar and interacinar distribution is found, and it is naturally suggested that this arrangement permits the development of acini during the functional period, and that, when the demand for acinar development is over, the elastica extends its boundaries, and, so to speak, seals up the duct cul-de-sacs. The freedom from restraint which the absence of elastica implies suggests that the cul-de-sac epithelium might readily extend beyond its natural boundaries into the parts around; in fact, the interesting hypothesis may be put forward that breast carcinoma develops because the elastica which ought to seal the duct termination has failed to do so. We hasten to add that we have no direct proof at present of this view, but from the evidence which we possess the supposition has a basis more secure than a pure hypothesis. That many breast carcinomata develop from duct epithelium apart from that which lines the duct cul-de-sac is a matter of everyday observation, and one beyond any possibility of dispute.

If I may summarize these somewhat rambling and inconclusive statements, I would say that "whole section" investigation has revealed the fact that a primary carcinomatous change most frequently originates in the epithelial tissue lining the ducts; in certain rare instances the tumor growth apparently originates in mammary rests of the so-called "sweat gland" type. *Ex hypothesi*, the unstable epithelial tissue of the terminal ducts would seem to be the most likely source from which a carcinoma would develop, but of this change no confirmatory evidence has been obtained.

THE SPREAD OF THE DISEASE

It seemed that a study of whole sections might afford a means of investigating the methods of spread of the disease, and, in pursuance of this idea, a large number of outline charts were made, upon each of which the various points of tumor incidence were located and recorded. Certain facts of interest were noted from this study.

Let me put this question of local spread and permeation in the simplest possible terms. It is conceivable that a malignant tumor, having originated in the breast, may extend along one or more of four different routes—

A. Along the lines and planes of fascial tissue or by tissue infiltration irrespective of any anatomical feature;
B. By the lymphatics;
C. By the blood vessels;

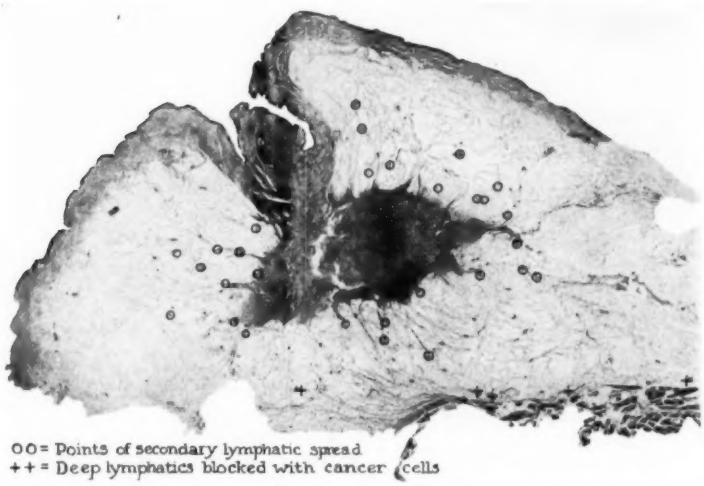

Fig. 17. Celloidin whole section of malignant breast. The primary lymphatic dissemination has become occluded and secondary channels are opening.

D. Along the continuity of the mammary ductal system.

A. *Tissue and fascial permeation.* We have received three distinct impressions in observing this aspect of tumor spread. The first is that tissue permeation is by no means so manifest in breast carcinoma as one had imagined it to be. Moreover, there is the curious fact that the more extensive the tumor the less is the degree and extent of tissue permeation, while in the early tumor tissue permeation and infiltration are more extensive. It is evident that, as the disease advances, tissue resistance is effectively stimulated.

The second impression concerns the distribution of the lines of spread. The fascial plane is the permeation line most frequently followed; actual infiltration of breast tissue apart from fascial distribution is less common. Even in the fascial distribution there is a curious selective influence for which it is difficult to advance any definite explanation. Time and again it will be observed that one side of a fascial line is infiltrated while the other side is free. It is apparent that the cancer cells follow the lines of least resistance, and that the distribution is largely guided by the degree of tissue tension which exists.

The third impression is in relation to the wonderful degree of immunity which striped muscle enjoys from the invasion of carcinoma cells. Even in the most advanced examples of the disease, cases in which the cancer is resting upon the pectoral muscle and the overlying fascia is extrensively involved, the muscular tissue either remains free from disease or is invaded only over a superficial area of its extent. It would be interesting and possibly important to explain this curious selective resistance of muscle.

B. *The local lymphatic spread.* Langhans was the first to draw attention to the part which the mammary lymphatics play in conveying the tumor cells beyond the growing edge of the disease throughout the breast substance, and this pioneer work was elaborated and confirmed by the classical researches of Heidenhain[1] and Stiles.[2] We have, moreover, the account which the majority of textbooks give of the cutaneous lymph arrangements, and much is often made of the importance of this lymphatic distribution in relation to mammary carcinoma, the influence of the subpapillary plexus described by Sappey,[3] and particularly that

[1] Heidenhain. Arch. f. klin. Chir., 1889, p. 97.
[2] Stiles. Brit. M. J., 1899, i, 1452.
[3] Sappey, Vaisseaux Lymphatiques, p. 17.

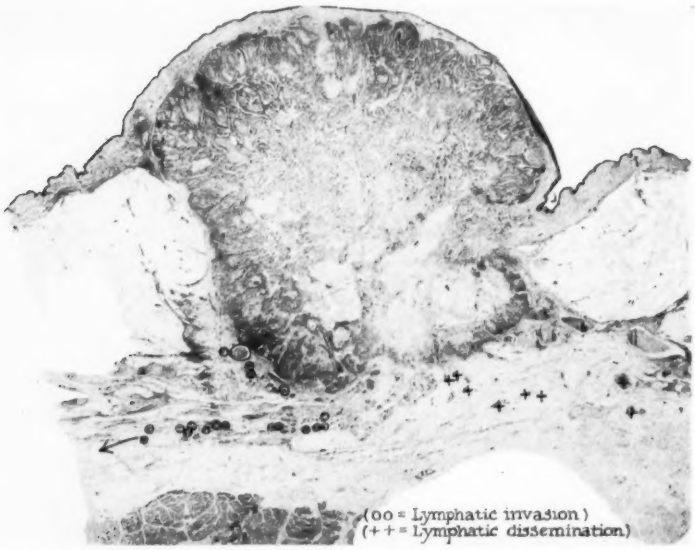

Fig. 18. Extensive breast carcinoma invading skin. Note that the lymphatic dissemination is *via* the submammary groups.

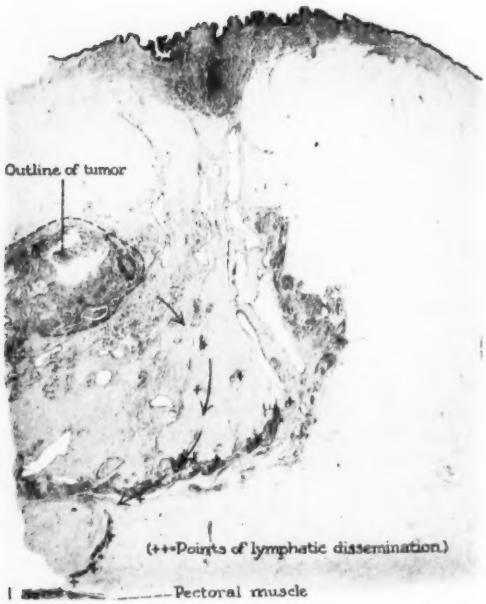

Fig. 19. Whole celloidin section, showing points of lymphatic dissemination from tumor.

portion of the plexus which lies in the subareolar tissues.

It was felt that the present investigation afforded an opportunity of recording the intramammary lymphatic spread, and an indication has already been given of the

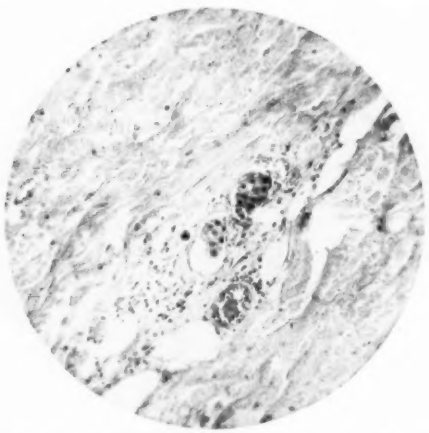

Fig. 20. Dissemination by blood stream. The small vessels contain groups of cancer cells. Case of mammary carcinoma. (× 160.)

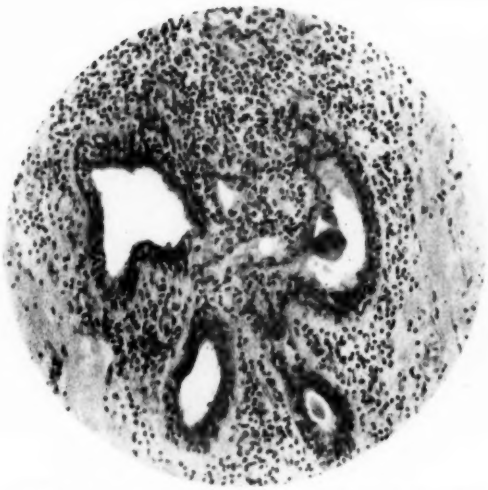

Fig. 21. Section of acini showing small group of malignant cells in the lumen of an acinus. (× 160.)

Fig. 22. Duct papilloma, the structure being of the radicular type. (× 60.)

method employed. An outline diagram of each breast as shown in whole section has been made; each section was then carefully traversed with the microscope, and each point of lymphatic spread was noted and allotted to its appropriate place on the corresponding chart. The results have been of interest.

Let us assume that a focus of malignant disease has originated in a breast. Lymphatic invasion is an early sequel, but in such an early case as we have visualized the conveyance of the malignant cells by the lymphatics is in a constant direction, and that is vertically through the thickness of the breast,

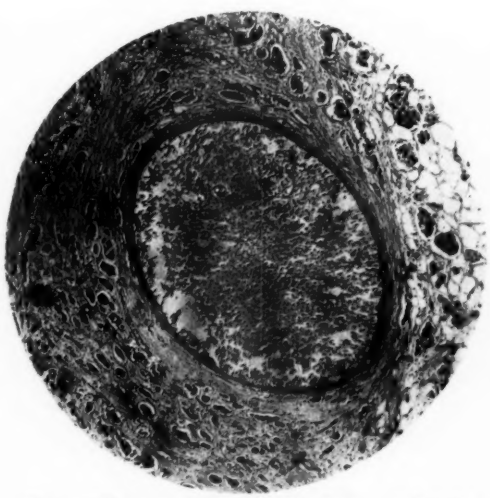

Fig. 23. Hyperplasia of duct epithelium secondary to a focus of malignant disease. (× 60.)

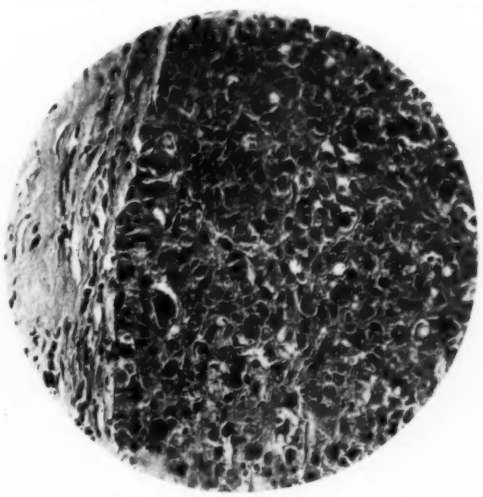

Fig. 24 (right). Section illustrating the type of cell resulting from duct epithelium hyperplasia. Note the large cell, the large nucleus, the active mitosis and the tendency to vacuolation. (× 300.)

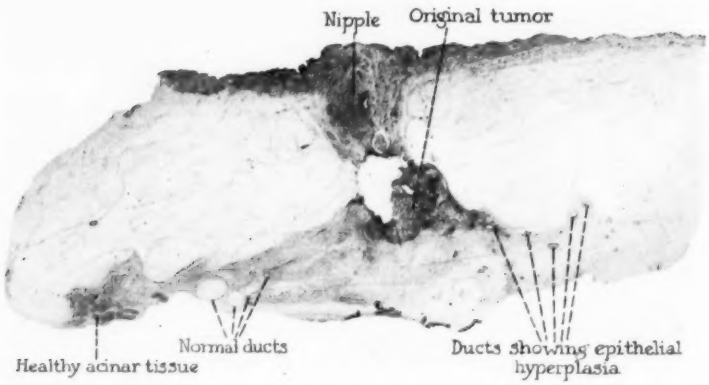

Fig. 25. To illustrate the extension of the duct hyperplasia from the original tumor.

particularly in the center of the organ and to the retromammary prepectoral fascia, whence the distribution is in a centrifugal direction. In whatever portion of the breast the primary tumor may originate, this scheme of primary central vertical lymphatic distribution is apparent.

Having gained entrance to the lymph stream, tumor cells evidently multiply with rapidity, so that in a short space of time the main central lymphatics become filled and effectually plugged with them. Under these conditions the obstruction which now exists to the normal lymph flow results in an opening up of a number of subsidiary channels which, though hitherto minute in size, have existed throughout the breast tissue, and particularly in the periductal and peri-acinar tissues. Quantities of minute cancer cell groups enter these enlarging subsidiary channels, and so a widespread and general lymphatic distribution arises throughout the breast. From what we have observed, the more general invasion is always secondary to the invasion of the central lymphatics, and their occlusion by growing cancer plugs.

We have been particularly interested to observe what part (if any) the subcutaneous lymphatic system plays in the dissemination of the disease. As far as our experience has gone, we have been unable to detect any lymphatic spread in this area. Even in tumors of such an extent and so superficial that considerable areas of skin were involved in ulceration, there was no evidence of a subcutaneous or cutaneous lymphatic dissemination. In certain specimens there has been evidence of dilatation of lymphatic vessels in the subcutaneous tissues, and it seems reasonable to assume that the dilatation has been in response to the closure of the deeper lymphatics, and it is possible that at a late stage of the disease these accessory lymphatics become the medium of a lymphatic spread, but in that event the process is a late one, and evidently an unusual one; there was at least no evidence of its occurrence in a series of fifty breasts representing all degrees of malignant invasion.

The cases which demonstrated the dilatation of the subcutaneous lymphatics were associated clinically with that pachydermatous condition of the skin which in many textbooks is spoken of as "cancer *en cuirasse*," but that the term so used is a misnomer was abundantly clear, for there was no cancerous infiltration, only a subcutaneous lymphatic engorgement and an œdema of the papillary structures of the skin.

To summarize, a study of lymphatic dissemination by the method of plotting the sites of infection suggests that the early lymphatic spread is through a central group of vessels which penetrate vertically through the breast center on to the retromammary fascia. Occlusion of the vessels follows as

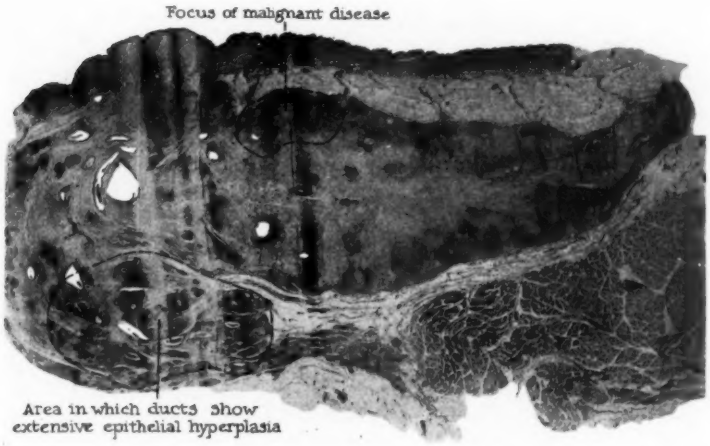

Fig. 26. The development of duct epithelium hyperplasia adjacent to focus of malignant disease.

the intramural deposits grow, and the derangement of the lymph flow which results is evidenced in the opening of numerous secondary channels hitherto potential rather than active. These channels enlarge and thereafter become the site of a widespread lymphatic dissemination throughout the breast tissue. At a later phase of the disease, the lymphatic involvement may be so great that the lymph stream is diverted through the subcutaneous groups, which in their turn dilate, yet which curiously enough rarely become the site of a further dissemination of the disease. In cases of so-called "cancer *en cuirasse*" a subcutaneous and cutaneous lymphatic engorgement is the distinctive pathological feature; there is no evidence of infiltration by malignant cells.

No discussion of the mammary lymphatics and the part they play in cancer dissemination would be complete without reference to Sampson Handley's[1] work. He believes that "cancer spreads on the parietal tissues by permeating the lymphatic system like an invisible annular ringworm. The growing edge extends like a ripple in a wider and wider circle, within the circumference of which healing processes take place, so that the ring of permeation at any one time is not a disc but a ring." I have quoted Handley's words, as they summarize his views on the dissemination of the disease, and our researches agree with the view which he and others have expressed, that dissemination extends by the lymphatics which are to be found throughout the deep submammary fascia, but we are unable to confirm his account of an annular dissemination by lymphatic permeation. In contrast to his experience, we have found the heaviest involvement of the lymphatics in the immediate proximity of the original growth, and this applies to all types of disease, early or advanced. Moreover, there has been no evidence of the fibrosis and destruction of cancer cells by which Handley explained the freedom of the immediate vicinity of the tumor from lymphatic cancer deposits. More than this we cannot say, as our research has not included examination of the tissues beyond the confines of the breast.

The impression which these sections has given is that the lymphatic invasion and extension are on an embolic basis rather than on the permeative principle which Handley has described; there was repeated evidence that the intralymphatic cells were items in an active circulation. It has seemed to us that these observations cannot be reconciled with a purely permeative explanation of cancer formation.

[1] Sampson Handley. Cancer of the Breast. 2d ed., 1922, p. 101.

Fig. 27. Transformation of complete breast into malignant tissue, tumor originating from duct epithelium.

C. *Dissemination by the blood stream.* The answer to the question, Does the blood stream act as a medium for the dissemination of disease in carcinoma of the breast? is best given by reference to Figure 20. Here there is apparent beyond any possibility of doubt a cluster of malignant cells within the lumen of the blood vessel. I think there can be no criticism of the accuracy of the anatomical situation. The cells are also in a state of active division, so that the stage may be said to be set for an active blood dissemination of the disease. Whether emboli of this nature are capable of producing metastatic foci of disease or whether, as Schmidt[1] suggests, they are destroyed by organization of the ensheathing thrombus cannot be stated from the evidence which we possess. At the most it can only be said that the illustration demonstrates the occurrence of cancerous blood emboli in cases of mammary carcinoma.

D. *Dissemination by the duct system.* Previous to this investigation, we had not sufficiently realized the part which the duct canal system may play in the dissemination of the disease. When one gives the matter thought, it seems reasonable to suppose that, if tumor cells gain access to the free surface of the duct system, they may eventually be distributed over widely separated parts of the interior; and yet I cannot recollect any statement in the literature of the subject which brings out this point with the distinction which it deserves. Again, I use an illustration as the evidence upon which the statement is based. Figure 21 is a microphotograph showing the outline of a breast acinus. Lying free in the lumen are several spheroidal-shaped cells which can be distinguished from the lining epithelium of the acinus. The shape is that of an irregular spheroid with variation in size; the staining reaction is characterized by the eosinophilic response of the cell body; the nuclei show hyperchromatosis and mitosis—a group of features which indicates the malignant character of the cells and their distinction from the healthy acinar tissue. It is evident that these cells have been borne by the fluid which bathes the ducts and the acini, that they have been carried from some distant focus into the recess of this acinus, where doubtless they will form the nucleus from which a fresh outbreak of disease will develop. As a matter of fact, in this instance the primary focus was situated in a segment of the breast far distant from that in which the acinar deposit existed.

It is clear that this method of dissemination is most likely to take place when the original tumor is one growing from the free surface of a duct, but, as we shall presently attempt to show, duct epithelium changes of a malignant nature are such a frequent accompani-

[1]Schmidt, M. B. Die Verbreitungswege der Karzinome. Jena: 1903.

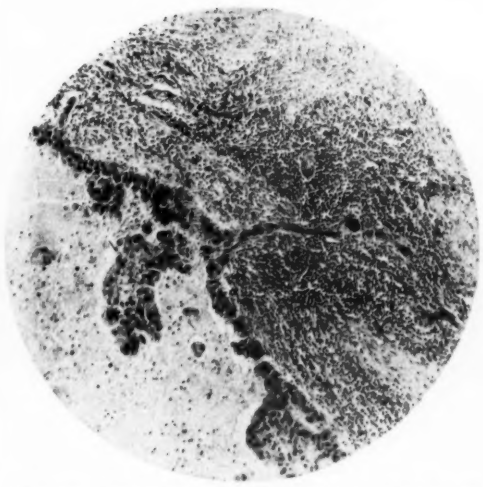

Fig. 28. Hyperplasia of duct epithelium. A chain of cells is invading the periductal tissue as a malignant infiltration. (× 140.)

Fig. 29. Hyperplasia of the duct epithelium with malignant infiltration of the surrounding tissues and the periductal lymphatics. (× 60.)

ment of breast carcinoma that the existence of this source must constantly be reckoned on. The methods by which the duct dissemination is produced are probably varied: the pressure of garments, handling the breast in the course of examination, even the contraction of the non-striped muscle which is incorporated in the breast.

THE ASSOCIATED PHENOMENA OF BREAST CARCINOMA

If anything was required to justify the investigation of breast tumors by the whole section method, it will be found in the evidence obtained regarding the changes which develop in a breast in association with the appearance of an original and isolated focus of malignant disease. It would seem that many of us assume that the pathological picture is a localized one, spreading, it may be, as the disease extends, yet developing within the limits of the continuity and the permeation of the multiplying malignant cells. The picture, however, is really a very different one. In the average case of breast carcinoma, what we may consider to be the original focus of disease is only one of a widespread series of changes. In fact, after studying the perspective, one may be inclined to be cautious in one's use of the term "original" as applied to a peculiar section of the tumor, for it is difficult to place the sequence of pathological events in their proper order.

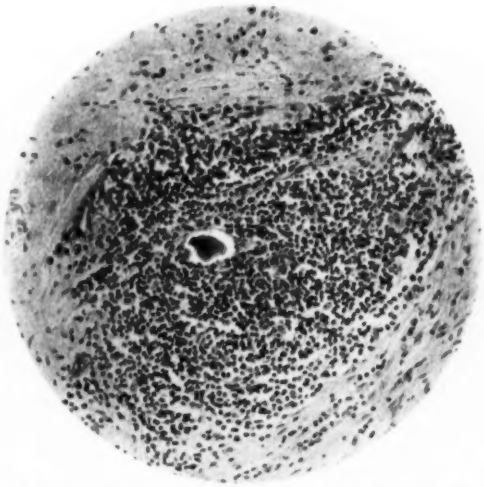

Fig. 30. A single duct epithelium cell has passed into the periductal tissues. Note the intense cell infiltration which its presence has induced. (× 160.)

Fig. 31. Mastitis carcinoma. Tumor arising from duct epithelioma. There is a widespread hyperplasia of the duct epithelium, and the extensive tumor infiltration has resulted from a malignant change of the hyperplastic epithelium.

Neglecting for a moment, however, this more debatable aspect, let us consider the more important of the associated changes, grouping them as A., duct changes, and B., acinar changes.

A. *Duct changes.* Cheatle has recently published a series of papers dealing with certain epithelial hyperplasias of the duct lining epithelium, and, having studied these various contributions, it was interesting to observe what whole breast sections revealed of the occurrence and of the distribution of such hyperplastic changes.

It is, we believe, a correct appreciation to recognize two types of duct epithelial hyperplasia: (1) that which is radicular in structure, provided with a vascular stem along which the blood supply is distributed, a type in which the lining epithelium, while greatly increased in surface extent, is not unreasonably exaggerated in thickness (this is the variety in fact which forms the intraductal and intracystic varieties of papilloma, simple or malignant), and (2) the non-radicular type, characterized by a proliferation of epithelial cells without any evident sign of supporting structure, a process by virtue of which large extents of duct area become filled with syncytial-like masses of proliferated epithelium.

It is evident that any association which may exist between the duct epithelium proliferation and an independent malignant focus affects only the second of these varieties, and we would add that, from what we have seen in whole breast sections, we believe the association to be a very close and important one.

The situation is this, that, in every malignant breast which we investigated, changes were apparent in the duct epithelium. After a study of these changes and their distribution we felt justified in arriving at certain conclusions.

a. *The changes are not those of an ordinary catarrhal process.*—This was made clear by at least two features. The cells, at first small and cubical, eventually became large in outline, polyhedral in shape, with a protoplasm which is clear in substance and occasionally vacuolated; further, there is no evidence of the leucocytic infiltration which accompanies a catarrhal process.

b. *The changes originate in proximity to a malignant focus and extend centrifugally from this center.* This is made evident by charting the distribution of the duct change in a series of specimens. The feature is at first an isolated one, but it spreads and extends until in some specimens it will be found to involve the entire duct system of the mamma.

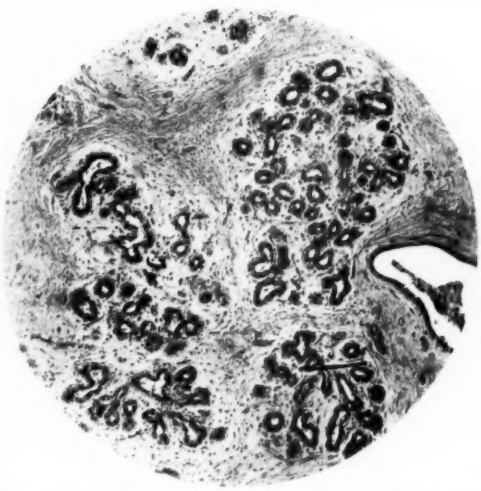

Fig. 32. The acinar structure of a normal breast. (× 60.)

Fig. 33. The transformation of acinar epithelium into malignant cells, the process arising secondary to a focus of malignant disease in the breast, and coincident with a generalized hyperplasia of duct epithelium. (× 60.)

c. *The cells are malignant.* While retained within the confines of the duct wall the cells proliferate and extend in the continuity of the canal, the proliferation being often so intense that the central elements are deprived of nutrition and break down into central neurotic areas, the "Commedone" carcinoma of Bloodgood. At a later stage, however, and under conditions which at present it is difficult to assess, the cells migrate from the intraductal space and pass into the periductal tissues. Here they assume the characters of true malignant cells, the shape alters in so far as they become smaller, probably as the result of a pressure to which previously they had not been subjected, they coincidentally lose their clear and vacuolated appearance (probably for a similar reason), they infiltrate the surrounding tissues, they pass into the lymphatics which are so numerous in the periductal spaces, and so they are distributed as malignant cells throughout the structure of the mamma.

A point of great interest is demonstrated in Figure 30. It is evident that these cells possess a property which exerts a harmful chemiotactic influence upon lymphocytes, and this is manifest as soon as the cell or cells pass beyond the limiting tissues. In the illustration indicated a single cell has passed through the duct wall, and its advent into the periductal tissues has been the signal for an intense surrounding accumulation of lymphocytic cells, a reaction which it is natural to assume has been in response to an irritative property of some description.

The relation of the duct epithelial change to the local focus of malignant disease is obscure. Is the duct epithelium hyperplasia a phenomenon which is reactionary to and dependent upon a stimulus produced by the already developed malignant focus, or is the duct change the original one, the cancer focus being a local malignancy in a more general and premalignant disturbance? Various points may be quoted for and against each of these views, and it is difficult to see how confirmation on either hand can be afforded. The impression we have received is that a local focus of malignancy first develops. A stimulus which has either acted in the production of the original forms or has arisen secondary to it is afterwards carried probably in a secretion along the duct surface, affecting the epithelium as it passes and inducing the characteristic hyperplasia, sometimes passing slowly and gradually, at other times extending freely and rapidly, so that the entire

breast duct system becomes involved. Except on some such basis as this it is difficult to see how one can explain the centrifugal extension of this duct change, an extension which is abundantly evident in many specimens.

The significance of duct epithelium changes secondary to a localized malignant focus has been one of the most striking features revealed in whole section examination. We have realized as never before how widespread are these potentially malignant changes, and the realization has altered our whole conception of the pathology of malignant disease. Cells far distant from the original focus and widespread in their distribution are subjected to a stimulus which converts the innocent cell of healthy function and natural growth into a tissue erotic in its growth and malignant in its characters. Further, it is impossible to overlook the significance of the fact that the responding element is a surface epithelium, and therefore subject to a fluid-borne or secretion stimulus.

B. *Acinar changes.* Reactionary changes in the acinar epithelium are as striking as those met with in the ducts. I show you in succession two sections, one illustrating the acinar structures of the healthy breast of a woman of 35 years of age, and in contrast to it a section of acinar tissue from the breast of a woman of similar age (35), but in this instance the breast was the site of a focus of cancer. The section illustrated was removed from a portion of the breast distant from the original tumor by a considerable area, and moreover it was from a segment which showed no naked-eye evidence of disease. The tissues are shown in a corresponding magnification (60 diameters) in order to demonstrate how striking are the distinctions, and it is apparent that the acini related to the malignant breast are undergoing a change by which the lining epithelium is being converted into cells endowed with the characteristics of malignancy. The cells have proliferated so as to distend the acini, they are of the large nucleated clear protoplasm type, the nuclei show hyperchromatosis and irregular mitosis, in places the acinar basement membrane is invaded and the cells have passed into the surrounding tissues, where they have behaved after the manner of malignant cells.

The picture is very similar to that described in relation to the duct changes, and the inference which we draw is similar, that the acinar cell change is a response to a stimulus carried throughout the ducto-acinar system, probably through the medium of a secretion.

There are various modifications of the process; it may be that the altered acinar cells are not of the large clear type, but of a small round-celled type, but the process remains the same—the conversion of acinar epithelium into a tissue with the characters of the fully malignant type, a change which may be widespread throughout the mamma.

SUMMARY

1. Whole sections of the breast afford an excellent opportunity of studying the complete mammary picture of breast carcinoma.

2. Studies of the virginal, marital, and senile breasts demonstrate the activity of the acinar epithelium, the epithelium which lines the cul-de-sacs of the terminal ducts.

3. The activities of proliferation and retrogression of the acinar epithelium are related to the arrangement of the elastica, for in the breast which is physiologically active the elastica does not enclose the duct terminations, while in the senile breast it extends so as to "seal up" the duct termination.

4. The classification of malignant breast tumors is unsatisfactory, and the difficulty is increased because several different types of tumor may occur in one breast.

5. Lymphatic dissemination of malignant tumor is by a vertical group of central lymphatics which extend centrifugally in the deep fascia; later intramammary lymphatics open up. There is no evidence that the subcutaneous lymphatics play a part in the dissemination.

6. Other sources of dissemination are the blood vessels and the duct system.

7. A localized malignant tumor is associated with widespread secondary changes in the duct and in the acinar system, these taking the form of an epithelial proliferation which ultimately becomes malignant.

PERITONITIS; AN EXPERIMENTAL STUDY[1]

By VERNON C. DAVID, M.D., Chicago

In a critical review of 11,000 cases of general suppurative peritonitis occurring in the leading German clinics during the last 30 years, Kirschner (10) shows that the general mortality has fallen enormously. Considering all causes it has dropped from 87.5 per cent in 1895 to 30 per cent in 1925. In general peritonitis following appendicitis the mortality has fallen from 83 per cent in 1895 to 20 per cent in 1924. A corresponding decrease in mortality in general peritonitis from practically all causes has occurred, except in postoperative peritonitis in which the mortality is still very high. These figures in a general way correspond to the improved mortality statistics found in reports from our own country and England.

This marked reduction in the mortality rate of general peritonitis is in most part due to early diagnosis, early, speedy and non-traumatic operation, which aims to eliminate the source of the infection; establishment of drainage when necessary, and proper after-treatment which includes, in this country, Fowler's position and maintenance of fluid balance, stomach lavage, and in certain instances the establishment of an ileostomy.

While improvement in diagnosis and technique may still lower the mortality, it seems probable that a further decrease in the death rate will be intimately concerned with a better understanding of the physiological and pathological processes involved in general peritonitis. These problems are extremely complex and involve many phenomena not well understood. That we are dealing with an infection of a cavity the surface of which equals that of the cutaneous surface of the body makes it evident that the questions of toxæmia and septicæmia are always in the fore in estimating the causes that lead to a fatal termination. The absorption of bacteria and toxins from the peritoneum with subsequent damage to the vasomotor apparatus, and the possible effect on the production of paralytic ileus may be weighed against the local effect of the bacteria and their toxins on the bowel, with the establishment of a paralytic ileus, portal stasis, and circulatory failure. Many other complex problems present themselves. In general these problems may be listed as to the question of absorption of bacteria and toxins from the peritoneal cavity, the problem of the production of paralytic ileus and its influence on mortality and, finally, the questions involved in the early circulatory failure so often observed in general peritonitis. Some light may be thrown on the general picture by a study of isolated problems that go to make up the whole.

The object of this communication is to review the work done on the problem of absorption from the peritonel cavity, and to present some experiments bearing on the subject of the passage of bacillus coli from the peritoneum. These experiments may indicate by analogy some of the processes which take place in general peritonitis.

ABSORPTION OF FLUIDS FROM THE PERITONEUM

In a study of the absorption of fluid from serous cavities Dybkowsky (7), in 1866, observed that there was an interchange of fluids between the blood stream and fluid in the pleural cavity, whereas solid particles were largely taken up in the lymph spaces. Magendie (14) observed that absorption of fluids from the pleura was more rapid if the volume of circulating blood had been diminished. From an experimental study on the absorption of fluid from the intestine Heidenhain (9) believed that vital characteristics of the cells influenced absorption of fluids into the blood stream. Following this work one of the most fundamental experimental studies was made by Starling, Tubby, Matthes and Leathesm (12, 16, and 21). They found that the absorption of fluids from the pleura and peritoneum obeyed almost entirely the laws of osmosis, and that it was not necessary to assume a vital character of the cells. Hypertonic solutions in the peritoneum increase in amount by

[1] From the Surgical Department of Rush Medical College.

absorption of fluid from the blood until the intraperitoneal solution becomes isotonic, when slow absorption takes place. Hypotonic solutions, on the other hand, are rapidly absorbed into the blood stream. Isotonic solutions vary in the rapidity of their absorption, some being rather rapidly absorbed at first, with a marked secondary slowing of absorption, while others, as normal blood serum, are absorbed very slowly and may be taken up by the lymphatics. To a lesser degree, after the death of an animal, the absorption of fluid solutions from the peritoneum obey the laws of osmosis (LePlay and May, 13).

Clairmont and Haberer (4) studied the absorption of sugar and potassium iodide from the peritoneum into the blood stream and their appearance in the urine. Drying of the intestines by evisceration retarded the absorption. Increase of peristalsis increased the rate of absorption. Prima (20) substantiated this observation, finding that the absorption was increased one-fourth to one-half and that no difference was observed between mechanical or chemical stimuli in increasing peristalsis. He also showed experimentally that opening the abdomen decreased the absorptive power of the peritoneum. Clairmont and Haberer irritated the peritoneum with croton oil, turpentine, stomach contents and bile, and found the rate of absorption of potassium iodide from such a peritoneum greatly increased. In a fully developed peritonitis, the rate of absorption was definitely slowed. If hypertonic glucose was injected into the peritoneum, the absorption of potassium iodide was not slowed. These authors attempted to exclude the diaphragm as an absorptive area by painting it with collodion, and found under such conditions that the secretion of potassium iodide in the urine was much delayed.

Achard and Gaillard (1) have shown that the higher the molecular weight of organic materials in the peritoneum, the lower will be the rate of absorption into the blood. Danielsen (6) concluded as the result of experimental work that crystalloids are absorbed from the peritoneum through the blood stream, and that colloid substances are absorbed from the lymph spaces. Fleisher and Loeb (8) performed nephrectomy or ligated the renal vessels and found an increased osmotic pressure of the blood, and an increased rate of absorption from the peritoneum. They found no direct relation between diuresis and absorption from the peritoneal cavity. Pertinent to these observations, Starling points out that the osmotic pressure of blood proteins is related to the absorption of fluid by blood vessels, in that increasing protein concentration of a peritoneal saline solution reduces the absorbing force to the hydrostatic pressure in the capillaries, when absorption ceases.

Bolton (2) concluded from his work that colloidal dyes, indiffusible outside of the body, pass through the peritoneum and capillary wall by diffusion directly into the blood, but slower than crystalloids. Colloids of a large molecular weight pass through much slower and it is probable that albuminous molecules are unable to do so. Klein (11) states that toxins of low concentration are absorbed rapidly from the peritoneum and that, conversely, toxins of high molecular weight are absorbed very slowly into the blood.

PASSAGE OF SOLID PARTICLES FROM THE PERITONEUM

It has been known that solid particles are taken up by the lymphatics in the peritoneum and are either carried to the retroperitoneal glands, or through the diaphragmatic lymphatics to the mediastinal glands and into the thoracic duct, or are absorbed in the lymphatics emptying directly into the thoracic duct. It was at first supposed that this absorption took place through stomata between the endothelial cells of the peritoneum, but Muscatello (17) demonstrated that the so-called stomata were artefacts. McCallum (15) contends that the endothelial surface of the peritoneum is continuous, and that particles passing through it are taken up by phagocytes, which property may be shown by lymph cells or the endothelial cells of the peritoneum. The mechanical effect of respiration has a great influence on the passage of particular matter through the peritoneum, and this may be demonstrated by establishing artificial respiration in a recently killed animal.

Cunningham (5) injected lamp-black intraperitoneally in cats. In 3 minutes it could be

demonstrated in the mediastinal glands. In 5 to 10 minutes some phagocytosis had taken place *in situ*. Evidence was presented to show that the particles were passing through the cytoplasm of the lymph cells and not between the cells.

Bolton injected silver nitrate solution into the peritoneal cavity of cats and found that it passed exclusively through the lymphatics, and that the force of respiration greatly increased the rate of absorption.

PASSAGE OF MICRO-ORGANISMS THROUGH THE PERITONEUM

Thiele and Embleton (22) injected micro-organisms into the peritoneal cavity and found that they appeared in the thoracic duct chyle in 2 to 10 minutes. If the thoracic duct had been previously tied, no organisms were found in the blood stream.

Peiser (19) injected bacteria into the peritoneum and describes their rapid appearance in the blood stream, followed by a period when only a few bacteria were found. Salt solution injected with the bacteria, or irrigation of the peritoneal cavity with normal salt solution, favors the rapidity of their absorption. He was unable to show changes in absorption which were influenced by posture of the body, as, for example, in Fowler's position.

Danielsen found that bacteria injected into the peritoneum appeared in the chyle but were not present in the blood stream if the thoracic duct had been divided. Buxton (3) found that typhoid bacilli injected into the peritoneum appeared in the blood quickly and were present in largest number 5 to 15 minutes after their injection, but were still present in the blood in decreasing numbers after an hour. Wells and Johnstone (24) conducted experiments in which bacillus coli and streptococci were injected into the peritoneal cavity. They found great quantities of micro-organisms in the thoracic duct after 15 minutes, but in decreasing numbers in an hour. Blood cultures were practically all sterile even though the thoracic duct was untouched, showing, in Well's and Johnstone's opinion, that the bacteria used did not live in the blood stream. They felt that proof had not been advanced that bacteria were absorbed directly into the blood stream from the peritoneal cavity. Twort (23), in similar experiments found the bacteria in the anterior thoracic glands and occasionally in pleural fluid. The submaxillary and submental glands remained sterile. Injection of oil into the peritoneum 15 to 30 minutes before injection of the bacteria made no difference in the results.

EXPERIMENTS

Our experiments are concerned with the passage of bacillus coli from the normal peritoneum, from the peritoneum which is undergoing different grades of peritonitis, and from the peritoneum which contains a transudate.

Healthy adult dogs of medium size which had been fed on a fat diet were used.

Passage of bacillus coli from the normal peritoneum. The questions involved are whether the bacillus coli injected intraperitoneally is taken up by the lymphatics alone, or whether it passes directly into the blood stream as well.

Experiment I. The thoracic duct was exposed in the neck and divided. The femoral artery was exposed and divided, the distal end ligated and the proximal end closed with a vessel clamp so that blood could be obtained for culture. Control cultures of 1 cubic centimeter of chyle and 5 cubic centimeters of blood were sterile. Twenty cubic centimeters of a bouillon culture of bacillus coli were injected intraperitoneally through a trocar inserted midway between the symphysis and ensiform.

Bacillus coli injected at 10:10

Chyle	Blood
10:14 sterile	10:15 sterile
10:18 1 colony	10:22 1 colony
10:21 many colonies	10:29 12 colonies
10:27 many colonies	10:36 5 colonies
10:29 8 colonies	10:39 2 colonies
10:32 many colonies	10:48 sterile
10:34 43 colonies	10:56 sterile
10:41 1 colony	
10:55 14 colonies	

This experiment and others giving substantially the same results show that the bacillus coli is taken into the blood stream directly, as well as into the lymphatic system, unless lymphatic channels are present on the left side of the neck which allow the bacillus coli to gain entrance into the blood through them. To establish conditions that would decide this point not only was the thoracic duct divided

on the left side, but the subclavian, innominate, internal, and external jugular veins were ligated on both sides of the neck in 3 dogs. Experiment I was repeated with the same results, showing that the presence of colon bacilli in the blood stream was not due to their entry through lymphatics in either the right or left side of the neck.

The question as to whether the bacillus coli was first taken up by the portal circulation and then gained access to the general circulation, was next considered.

Experiment 2. Part of the right lobe of the liver in a medium sized dog was extraperitonealized by drawing it outside of the abdomen through a right rectus incision and sewing the peritoneum around it, so that it lay on the anterior abdominal wall. The remaining layers of abdomen were closed around it. The thoracic duct was divided and the femoral artery was prepared as in Experiment I. Control cultures of 5 cubic centimeters of femoral arterial blood, 2 cubic centimeters of liver blood, obtained by shaving off a piece of liver and aspirating the blood into a sterile pipette, and 1 cubic centimeter of chyle from the thoracic duct were sterile. Twenty cubic centimeters of a 24-hour bouillon culture of bacillus coli were injected intraperitoneally, as in Experiment I.

Bacillus coli injected at 10:50

Chyle	Blood
10:55 sterile	10:57 sterile
11:02 countless	
11:02 countless colonies	11:05 20 colonies
11:07 countless colonies	11:10 60 colonies
11:10 countless colonies	11:21 15 colonies
11:25 countless colonies	11:29 35 colonies
11:46 countless colonies	11:48 40 colonies
11:52 many but fewer	
12:05 16 colonies	

Liver blood
10:57 sterile
11:02 12 colonies
11:08 25 colonies
11:20 4 colonies
11:27 2 colonies
11:43 10 colonies
11:54 1 colony
12:08 4 colonies

This same experiment was repeated, pieces of liver being taken which were ground and cultured. Two to four colonies of bacillus coli were obtained from each cube of liver tissue, which was about three-fourths of an inch square.

The same experiment was repeated except that the spleen was extraperitonealized. The blood from the spleen showed 1 to 3 colonies of bacillus coli in 2 to 3 cubic centimeters of blood, to 8 to 40 colonies obtained from 5 cubic centimeters of femoral arterial blood. The time of appearance of bacillus coli in the blood of the liver and the spleen was about the same as the time of its appearance in the femoral blood.

These experiments in which bacillus coli was injected intraperitoneally and subsequently appeared in the chyle, peripheral blood stream, liver and spleen, demonstrate that

1. The bacillus coli appeared in the chyle from the thoracic duct in 5 to 12 minutes, the maximum number occurring from 30 to 45 minutes after its intraperitoneal injection, when it began to decrease in numbers.

2. Bacillus coli appeared in the peripheral blood in 12 to 18 minutes, reaching a maximum in about 20 minutes, after which it tended to decrease in number.

3. Bacillus coli appeared in the liver tissue and blood from the liver and spleen at about the same time the micro-organisms appeared in the general blood stream. There appeared to be more micro-organisms in the peripheral blood stream than in the liver or spleen.

4. Evidence is presented that bacillus coli is taken up directly into the blood stream from the peritoneum as well as directly into the lymphatics. It appeared earlier in the chyle and in greater numbers per unit of measurement.

5. After the first rapid appearance of the micro-organisms in the blood and chyle they seemed to decrease in numbers.

Passage of bacillus coli from the inflamed peritoneum. The next question investigated was whether peritonitis would influence the passage of bacillus coli from the peritoneum. In order to establish different grades of non-infectious peritonitis varying from a hyperæmia to a well developed plastic exudate we used intraperitoneal injections of turpentine emulsion. After the turpentine injections, barbital was given hypodermically to keep the animal comfortable. The results of these intraperitoneal injections of turpentine were as follows:

1. Twenty cubic centimeters of a 50 per cent turpentine emulsion injected intraperi-

toneally caused a fatal, plastic peritonitis, with marked hyperæmia of the visceral and parietal peritoneum, agglutination of the intestinal loops, and from 200 to 300 cubic centimeters of bloody fluid in the peritoneal cavity. Paralytic ileus was not observed in any experiment.

2. Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally in both the upper and lower abdomen usually caused a marked plastic peritonitis in 24 hours, which was usually nonfatal, though the animal became apathetic and sick.

3. Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally 7 days and 1 day before the postmortem usually caused a hyperæmic peritoneum with some bloody fluid and a slight plastic exudate.

4. Ten cubic centimeters of a 5 per cent turpentine emulsion injected intraperitoneally one week before the postmortem usually showed but a slight hyperæmia of the peritoneum.

The passage of bacillus coli into the lymphatics and blood stream from the peritoneum which was the seat of an inflammatory process was next studied.

Experiment 3. Forty-eight and twenty-four hours before the experiment 10 cubic centimeters of a 5 per cent turpentine emulsion were injected into the upper and lower peritoneum. On the morning of the experiment a small laparotomy incision was made and a trocar was inserted between intestinal loops. The abdominal wall was tightly closed in layers around the trocar. The thoracic duct was divided and the femoral artery was exposed as already described. Control chyle and femoral arterial blood were sterile. Twenty cubic centimeters of a 24-hour bouillon culture of bacillus coli were injected through the trocar into the peritoneum.

Bacillus coli injected at 10:27

Chyle	Blood
10:31 sterile	10:33 sterile
10:37 sterile	10:35 sterile
10:44 sterile	10:46 sterile
10:52 sterile	10:52 sterile
10:57 sterile	10:59 sterile

At postmortem there was a marked plastic peritonitis with 300 cubic centimeters of bloody fluid in the peritoneal cavity. Culture of this fluid showed a rich growth of bacillus coli. The parietal and visceral peritoneum was hyperæmic and covered with thick plaques of fibrin.

One other dog studied under the same experimental conditions gave the same results.

Experiment 4. An effort was made to establish a peritonitis of milder grade, with some bloody fluid and only a slight plastic exudate. Three dogs were thus studied. The bacillus coli was injected high in the abdomen between the liver and stomach, in the posterior portion of the peritoneum behind the intestines, and midway between the symphysis and ensiform. In all three experiments the peritoneum showed hyperæmia and a very slight fibrinous exudate on the visceral and parietal peritoneum. From 50 to 100 cubic centimeters of bloody fluid were present in the peritoneum of each of these 3 dogs.

Experimental conditions were established as in Experiment 3. The blood of all three animals remained sterile. The chyle was sterile in one animal but contained many colon bacilli in the other two. The detail of one experiment will be given.

Ten cubic centimeters of 5 per cent turpentine emulsion were injected intraperitoneally 2 days and 1 day before the experiment. A trocar was inserted into the peritoneum through a small incision, as in Experiment III. The thoracic duct was divided and the femoral artery exposed. The control blood and chyle were sterile. Twenty cubic centimeters of a 24-hour bouillon culture of bacillus coli were injected through the trocar into the peritoneum.

Bacillus coli injected at 10:07

Chyle	Blood
10:10 sterile	10:11 sterile
10:14 few colonies	10:17 sterile
10:21 many colonies	10:24 sterile
10:27 many colonies	10:28 sterile
10:34 many colonies	10:37 sterile
10:42 many colonies	10:51 sterile
10:50 many colonies	11:00 sterile
10:59 diminishing number	
11:03 diminishing number	

Postmortem showed 100 cubic centimeters of bloody peritoneal fluid and very slight fibrinous exudate.

Experiment 5. In three dogs having a hyperæmia of the peritoneum, but with no fluid or fibrinous exudate, the passage of bacillus coli from the peritoneum was studied. The blood remained sterile in all 3 animals following the intraperitoneal injection of bacillus coli, but in 2 of the animals the chyle contained the usual number of bacilli coli. In the remaining animal both blood and chyle were sterile. The details of only one experiment will be given.

Four days and one day before the experiment the dog received 10 cubic centimeters of 5 per cent turpentine emulsion intraperitoneally. Through a small laparotomy wound the end of a trocar was inserted into the depth of the cul-de-sac of Douglas. The abdomen was closed tightly in layers around the trocar. The thoracic duct was divided and the femoral artery was exposed as in former experiments. A control culture of chyle and blood was sterile. Twenty cubic centimeters of a 24-hour bouillon cul-

ture of bacillus coli were injected through the trocar into the peritoneum.

Bacillus coli injected at 10:26

Chyle	Blood
10:29 sterile	10:31 sterile
10:34 3 colonies	10:42 sterile
10:40 sterile	10:46 sterile
10:52 sterile	10:52 sterile
11:01 many colonies	11:04 sterile
11:07 many colonies	11:10 sterile
11:17 many colonies	11:20 sterile
11:22 2 colonies	11:22 sterile

At postmortem the peritoneum showed a slight hyperæmia but no bloody fluid or plastic exudate.

We may conclude from these experiments that

1. In a well developed plastic peritonitis with bloody peritoneal fluid caused by the injection of turpentine into the peritoneum of dogs, the passage of colon bacilli into the lymphatics or blood stream is practically nil.

2. Where the peritonitis is chiefly shown by hyperæmia and bloody intraperitoneal fluid, with a slight amount of plastic exudate, the colon bacilli are usually taken into the chyle through the lymphatics but the blood remains sterile when the thoracic duct has been divided.

3. When only hyperæmia without gross exudate in the peritoneum is present, following the intraperitoneal injection of turpentine, colon bacilli are usually taken into the chyle through the lymphatics but the blood is sterile when the thoracic duct has been divided.

4. All of the factors present in these experimental types of peritonitis which prevent the passage of bacillus coli into the blood stream or into the lymphatics in severe plastic peritonitis are not known, but the most important one to consider is the injury to the peritoneum and blood vessels by an inflammatory agent which produces hyperæmia, serosanguinous and plastic exudate. These products of inflammation are identical to those found in bacterial peritonitis. It may be fair to assume by analogy, therefore, that the frequent fatal outcome in general peritonitis with plastic exudate is not due to the passage of micro-organisms from the peritoneum through the lymphatics or directly into the blood stream.

The last problem studied concerns the influence of a peritoneal transudate on the passage of bacillus coli from the peritoneum.

It has been suggested by several investigators that general peritonitis should be treated by the intraperitoneal injection of hypertonic glucose solution on the principle advanced by Wright in the treatment of infected wounds by hypertonic solutions with a consequent lymph lavage. Narat (18) reported unusual benefit in the treatment of experimental peritonitis by the intraperitoneal injection of hypertonic glucose solution. As has been stated, Starling and his associates established the fact that the laws of osmosis govern the interchange between intraperitoneal hypertonic solution and the blood. The increase in volume of a hypertonic solution in the peritoneal cavity continues until the hypertonic solution becomes isotonic, when it is slowly absorbed. These facts have been corroborated by many observers. Narat says that a rabbit can tolerate 1/50 of its body weight of 20 per cent glucose solution which in an hour has increased its volume to 85 cubic centimeters and in 3 hours to 110 cubic centimeters.

In estimating what amount of hypertonic glucose solution a dog could tolerate intraperitoneally, we gave 2 dogs, intraperitoneally, 200 grams of glucose dissolved in 240 cubic centimeters of water. They both died the same day, with muscular twitchings, frothy mucus in the lungs and throat, and concentrated urine which contained sugar, blood, and albumin. The intestines were contracted and contained bloody mucus. The peritoneum was hyperæmic and contained 775 and 1,000 cubic centimeters respectively of blood stained fluid, the sugar content of which was 8 per cent and 4.3 per cent respectively. The blood sugar was 666 and 582 respectively.

On further investigation we found that a medium sized dog would stand the intraperitoneal injection of 50 grams of glucose dissolved in 90 cubic centimeters of fluid. One hundred grams of glucose dissolved in 125 cubic centimeters of fluid given intraperitoneally would not kill the dog if after injection intravenous isotonic salt or glucose solution were given, or if the dog drank large quantities of water.

Experiment 6. A medium sized dog was given 25 cubic centimeters of 50 per cent glucose solution

intraperitoneally 12 hours before the experiment. The thoracic duct was divided and the femoral artery exposed. Control chyle and femoral arterial blood each contained one colony, which was not bacillus coli. Twenty cubic centimeters of 24-hour bouillon culture of bacillus coli were injected intraperitoneally.

Bacillus coli injected at 11:44

Chyle	Blood
11:51 sterile	11:56 9 colonies
11:53 sterile	11:57 1 colony
11:57 sterile	11:59 400 colonies
12:03 128 colonies	12:05 800 colonies
12:10 960 colonies	12:14 1920 colonies
12:20 2240 colonies	12:22 countless
12:30 countless	12:32 countless

Postmortem examination showed a hyperæmia of the parietal and visceral peritoneum with 300 cubic centimeters of bloody fluid in the peritoneal cavity.

Two other dogs were studied in the same way with the same result, each animal giving a very abundant growth of bacillus coli from the divided thoracic duct and from the peripheral blood stream. To the end of the experiment, 45 minutes after the intraperitoneal injection of bacillus coli, there was no tendency for the micro-organisms to diminish in number in either the chyle or in the blood.

We may conclude from these experiments that the bacillus coli injected into the peritoneum, which contains a transudate formed by the previous injection of hypertonic glucose solution, passes rapidly into the lymphatics and into the blood stream. The number of organisms appearing in the thoracic duct and blood under these conditions is much greater than that found from the normal peritoneum. Whatever benefit hypertonic glucose solution may have in the treatment of peritonitis, it is probably not due to the inhibition of the passage of micro-organisms into the blood and thoracic duct lymph.

CONCLUSIONS

1. Evidence is presented that colon bacilli pass directly into the blood stream as well as into the lymphatics from the normal peritoneum.

2. A well developed plastic peritonitis prevents the passage of bacillus coli from the peritoneum into the blood stream or into the lymphatics emptying into the thoracic duct.

3. Lesser grades of peritonitis prevent the passage of bacillus coli into the blood stream but usually do not prevent its passage into the lymphatics.

4. Colon bacilli, injected into the peritoneum which contains a transudate, pass rapidly and in great numbers into the chyle from the thoracic duct and directly into the blood stream.

5. By analogy we may assume that in a well developed general infectious peritonitis, bacteria do not pass directly into the blood stream or into the lymphatics draining into the thoracic duct, and that the major problem in peritonitis does not concern itself with the development of a septicæmia.

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LATE RECURRENCE OF PEPTIC ULCER AFTER GASTRO-ENTEROSTOMY

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DURING the last few years there has been a very lively discussion among surgeons as to the indications for and merits of the operation of gastro-enterostomy for peptic ulcer, with marked divergence of opinion. It should be emphasized at the outset that peptic ulcer of the stomach is a very different disease from peptic ulcer of the duodenum. Although the two lesions may and probably do have a common cause, the clinical entities are quite distinct in their progression, prognosis, and treatment.

For the treatment of gastric ulcer surgeons practically unanimously agree that gastro-enterostomy alone is not an adequate procedure, and should only be used in those rare cases in which local or general conditions are such as to render more radical measures difficult or hazardous. Excision of the ulcer, or its destruction by the cautery (Balfour method) combined with gastro-enterostomy, and partial gastrectomy are the measures most generally recommended. Moynihan (15) advocates whole-heartedly partial gastrectomy for gastric ulcer in the great majority of cases. He states in the last edition of his book *Abdominal Operations* that in the 10 years up to 1923 the mortality in cases of gastric ulcer in which gastrectomy was performed was 1.6 per cent. During this time he operated in 531 cases of duodenal ulcer and 164 cases of gastric ulcer. He has observed no jejunal ulcers or other untoward late results in the cases subjected to partial gastrectomy.

Balfour (3), the originator of the cautery method, states that partial gastrectomy is becoming more and more the operation of choice in cases of chronic gastric ulcer. In an analysis of 58 cases of ulcer of the stomach operated on at the Mayo Clinic between January 1, 1924, and the date of his paper, one half had been subjected to partial gastrectomy.

An undeniable advantage claimed for this operation is complete removal of the lesion, which is of particular importance since these ulcers have been shown to have a certain tendency to become malignant. It also permits of the removal of multiple gastric ulcers. This view steadfastly advocated by Rodman (17) of Philadelphia many years ago is now held by many prominent surgeons in Europe and in this country.

When we consider duodenal ulcer we find on the other hand a very great divergence of opinion as to the best surgical procedure. The great majority stand by gastro-enterostomy: W. J. Mayo (13), Moynihan (15), Peck (16), Sherren (19), Woolsey (20), Balfour (4), Scudder (18), and a host of other well-known surgeons have enthusiastically endorsed this operation properly performed in selected cases of chronic duodenal ulcer. Impressive statistics have been adduced in support of their views.

Balfour (2) in 1924 reported the end-results of 1,000 cases of gastro-enterostomy for duodenal ulcer operated on at the Mayo Clinic more than 10 years previously. He found satisfactory results in 88 per cent of cases. Sherren (19) of London has reported 92.6 per cent of 500 cases perfectly well two or more years after operation. Both Balfour (1) and Sherren have stated that if there is relief from symptoms from 18 months to 2 years after gastro-enterostomy, further recurrence is extremely unlikely. Such has not been my own experience. Peck (16) has reported 90.5 per cent of patients free from symptoms after gastro-enterostomy.

From my own hospital, the Massachusetts General, Scudder (18) in 1922 reported the remote results in 94 cases of gastro-enterostomy for duodenal ulcer, the time elapsed since operation varying from 1 year to 5 years. He found that 88 cases or 93.6 per cent were practically well.

Since the publication of Scudder's careful and painstaking report 7 patients have re-

entered the hospital with gastrojejunal ulcers who had had gastro-enterostomy performed there during the period covered by the report; 6 of these might well have been included among those considered practically well at that time, as they had been free from symptoms for periods ranging from 3½ years to 10 years until shortly before re-admission. In all 7 cases the diagnosis was proved by secondary operation. The details of some of these cases are included in the summary of personal cases at the end of this article. Although these subsequent recurrences are not perhaps sufficient in number to substantially alter Dr. Scudder's favorable percentages, yet they are sufficiently distressing to the patient and harassing to the surgeon as to somewhat shake one's confidence in the lasting security of results obtained by gastro-enterostomy.

Finney (6) in 1902, in looking about for a substitute for gastro-enterostomy, brought out his modification of the operation of gastro-duodenostomy for certain selected types of duodenal ulcer. Judd (9) has proposed the excision of those duodenal ulcers which show a marked tendency to hæmorrhage, where the local conditions permit of its performance. Such cases constitute perhaps 12 to 15 per cent of the total number of cases. Finney has combined excision with his original operation. Operations of this type have received quite general recognition in this limited field even from the advocates of gastro-enterostomy.

Many prominent continental surgeons finding the results of gastro-enterostomy for duodenal ulcer unsatisfactory, notably Haberer (8) and Finsterer (7), have turned to more radical measures. Haberer in 1920 reported 80 cases of partial gastrectomy by the Billroth I method without mortality; 35 of these were done for duodenal ulcer. In 536 gastrectomies he has never observed the development of jejunal ulcer.

In this country Lewisohn (10) traced 68 patients at the Mt. Sinai Clinic 4 to 9 years after gastro-enterostomy for duodenal ulcer, and found that 18 per cent of these cases required reoperation for gastrojejunal ulcer. Another 16 per cent had the clinical signs and X-ray findings of gastro-jejunal ulcer, making a total of 34 per cent. Only 50 per cent of his cases seemed to be pemanently cured by gastro-enterostomy. As a result of his studies and experience he draws the bold conclusion "that partial or subtotal gastrectomy should be the method of choice in the surgical treatment of gastric and duodenal ulcers."

Gastrojejunal ulcer is without doubt the most serious and distressing sequela of gastro-enterostomy. Many questions at once arise as to this complication. What is its cause? How often does it occur? Can it be prevented? What is its treatment? The last question is the most readily answered. As the result of increasing experience with these formidable cases it has become pretty generally accepted that undoing of the gastro-enterostomy, excision of the ulcer, and partial gastrectomy is the operation of choice for gastrojejunal ulcer. Undoing of the gastro-enterostomy, excision of the ulcer, and gastro-duodenostomy is advocated by some surgeons when the local conditions at the duodenum are favorable. Simple excision of the ulcer, or simple undoing of the gastro-enterostomy have proved to be inadequate procedures in cases in which the original operation was done for a definite chronic duodenal ulcer.

As to etiology it is obvious that just so long as the cause of peptic ulcer itself remains undetermined, the cause of gastro-jejunal ulcer will remain obscure, the underlying causes of the two conditions undoubtedly being identical. Many causative factors have been assigned: (1) infection from a distant focus either within or outside the abdomen which has not been removed; (2) irritation of non-absorbable sutures at the stoma; (3) trauma or hæmatoma at the time of operation; (4) poor drainage of the stomach, the result of the stoma being too small or improperly placed; (5) improper diet after operation, especially excess in alcohol or tobacco; (6) action of the acid gastric secretion on the mucous membrane of the jejunum. This last, the so-called acid erosion theory, is generally considered to be by far the most important factor. The experimental work of Mann and Williamson (11) and Morton (14) on dogs strongly supports this theory. This brings up another query. Does gastro-enterostomy materially reduce the acidity of the gastric secretion?

Lewisohn (10) says it does not in the majority of cases, while claiming that partial or subtotal gastrectomy effectually does do this. He also states that it is a well-known fact that gastrojejunal ulcers practically never occur in an anacid stomach.

Sherren (19) found in 285 cases of gastro-enterostomy only 37 in which the acidity was not reduced. Woolsey (20) believes that if gastro-enterostomy fails to reduce acidity this failure is due to some error in technique. Balfour (4) in a paper read before the American Surgical Association in 1926 reported 270 cases of gastrojejunal ulcer operated on at the Mayo Clinic. In 139 of these cases the original operation had been performed at the Mayo Clinic. The total number of gastro-enterostomies for peptic ulcer performed at the Clinic up to this time had been 8,600, giving a percentage of gastrojejunal ulcers of 1.6 per cent.

Moynihan's percentage is about the same. Woolsey places it at 2 per cent. Balfour further says "the fact that there was no free hydrochloric acid in one-fifth of the cases of gastrojejunal ulcer in which repeated and fractional examinations of the gastric contents were made disproves the assumption that achlorhydria following the primary operation affords protection against later ulceration."

Lewisohn (10) states: "We seem to have one safe way of preventing a recurrent ulcer or a subsequent gastrojejunal ulcer, that is, the establishment of permanent anacidity by partial or subtotal gastrectomy."

On the other hand C. H. Mayo (12) states that he has observed during the past year 2 cases of gastrojejunal ulcer following partial gastrectomy. A few similar experiences have been reported by others.

Out of this maelstrom of conflicting facts and opinions, what is to guide the course of the bewildered average surgeon? Although somewhat shaken in my former faith in gastro-enterostomy I must acknowledge the logic and force of the views so well expressed recently by Balfour (5) in its defense.

Let us then hold fast to that which has proved fairly satisfactory in the past until the newer and more radical measures have been thoroughly tried out by a few skillful and bold pioneers and proven to be better. To paraphrase the immortal bard, let us rather for a time bear those ills (of gastro-enterostomy) we have, than fly to others that we know not of. No one could criticize a Mayo or a Moynihan if he should see fit to extend the scope of partial gastrectomy for peptic ulcer. But only incalculable harm could result from the general adoption of the principle of gastrectomy for duodenal ulcer by the average surgeon.

Reserving gastrectomy, then, for the severe cases of gastric ulcer, and those intractable cases of recurrent ulcer following gastro-enterostomy, let us make sure that when we do perform gastro-enterostomy for duodenal ulcer that definite indications are present; that medical treatment has had a fair trial, that foci of infection elsewhere in the body have as far as possible been removed, that the operation is properly performed, and finally that a careful dietary and hygienic regimen is carried out subsequently.

It is important that further data on the results of gastro-enterostomy be secured. The occurrence of late sequelæ, such as recurrent duodenal ulcer and gastrojejunal ulcer after years of apparent well-being, make it imperative that follow-up studies be carried on with the pertinacity and thoroughness that are required in cancer statistics. Every case should be traced for 5, or better, 10 years. X-ray studies and analyses of gastric secretions should be made. When such reports are at hand from many diverse clinics we shall be in a much better position than we are today to appraise justly the operation of gastro-enterostomy for ulcer.

CASE REPORTS

CASE 1. A. Mc. M., Hospital No. 242597, male, 50 years old, American, entered the hospital April 20, 1921. He had had a posterior gastro-enterostomy done at another hospital 7 years previously for what was considered to be carcinoma of the pyloric end of the stomach with obstruction. Linen sutures were used. He was free from symptoms for 6 years and 9 months after operation. Then he began to have severe pain, indigestion, and vomiting. X-ray showed that the barium meal left the stomach entirely via the pylorus. The duodenum was irregular, suggesting old scar or recent ulcer. Test

meal: free hydrochloric acid 30, total acid 50. At operation a subacute perforation of a chronic duodenal ulcer was found. This was closed by suture. There was also a jejunal ulcer, the stoma of the old gastro-enterostomy was the size of a lead pencil. No sign of the old sutures was seen. The old gastro-enterostomy was undone, the jejunal ulcer excised, and a new gastro-enterostomy was made. He made a good immediate convalescence.

The later history of this case is unknown but in view of subsequent experience in these cases, I am not optimistic concerning the result.

CASE 2. E. H. T., Hospital No. 251174, male, 18 years old, American, first entered the hospital April 27, 1917. A posterior gastro-enterostomy with infolding of the duodenal ulcer and appendectomy was performed by another member of the staff. Some linen was used in the sutures. He was fairly well for 3½ years following his operation. On August 1, 1922, over 5 years after the first operation, he re-entered on account of epigastric pain and fainting spells. Transfusion was done twice while he was in the hospital. The hæmoglobin was recorded once at 15 per cent and red cells 1,100,000. He was relieved by Sippey treatment and discharged.

In March, 1923, he was again re-admitted on the medical service with marked anæmia and tarry stools. He had followed the Sippey régime with great faithfulness. After a transfusion, he was transferred to the surgical service, with hydrochloric acid, 31; total acidity 57. At operation there were marked adhesions about the duodenum but no induration or other evidence of active ulcer; the stomach appeared normal. The gastro-enterostomy stoma admitted 2 fingers. About an inch from the stoma on the proximal loop of the jejunum there was an area of induration with a crater. This ulcer of the jejunum was excised without disturbing the gastro-enterostomy.

Six months later he was again admitted with constant severe gnawing pain unrelieved by food, no vomiting, no tarry stools. The X-ray showed that the stomach emptied in a few minutes via the stoma, "dumping type." A small amount of barium was left by the pylorus. He was operated on for the third time; many adhesions about the stomach were found, but no evidences of definite gastric or duodenal ulcer were discovered. There was induration about the stoma and evidence of a jejunal ulcer; this was excised and the original gastro-enterostomy closed. The patient had postoperative pneumonia, otherwise the convalescence was uneventful. He was now, after his third operation, put back in his original condition before any operation had been performed on his alimentary tract.

Eight days after his discharge from the hospital he was re-admitted in an alarming condition from hæmorrhage. Large quantities of blood had been vomited and passed in the stools. Two transfusions were done. Morphine, rest, and starvation, caused the bleeding to stop. On a restricted diet he gradually improved and 6 weeks later was sufficiently well to be able to leave the hospital. Since that time, December, 1923, to date, he has been on an absolute milk diet devised by himself. He is free from symptoms and has the general appearance of good health though slightly pasty looking. He is able to carry on an active insurance business.

In spite of the terrible ordeal of unfortunate surgery through which this man has passed, he is now apparently happy and well, and cheerfully remarks that his sustenance costs him less than a dollar a day. This happy result cannot be credited to the surgery employed in his behalf, but is due to the pluck and perseverance of the patient, and the healing power of nature.

CASE 3. E. P., Hospital No. 263480, Canadian gardener, male, 22 years old, entered the hospital June 9, 1924. He had had an operation said to be a gastro-enterostomy for ulcer at another hospital 2½ years previously with relief of symptoms for 6 months. Then the original symptoms of pain and vomiting recurred. The X-ray showed some delay in the passage of the barium through the stomach, all barium leaving by the pylorus. There was some irregularity on the lesser curvature and at the duodenum. There was no evidence of a gastro-enterostomy stoma. The test meal resulted in free acid 55, total acid 65. At operation a posterior gastro-enterostomy was found, the stoma just admitting one finger. There was marked induration of the jejunum close to the stoma. There was the scar of an old ulcer at the duodenum with very little induration. The gastro-enterostomy was undone, and a small but definite jejunal ulcer excised. The patient made a good immediate recovery but 7 months later he re-entered the hospital with recurrence of symptoms of pain after eating, and frequent vomiting not relieved by soda or diet. The X-ray showed retention of over one third of the motor meal at 6 hours. There was a persistent irregular filling defect in the first portion of the duodenum. The free hydrochloric acid was 66, the total acid 80. At the third operation on February 11, 1925, a very definite ulcer of the first portion of the duodenum was found with induration and adhesions. The stomach itself was not remarkable. The antrum of the stomach consisting of a portion 3½ to 4 inches long was resected by the Billroth II method including the site of the previous gastro-enterostomy. He made a fair recovery, but had some postoperative bleeding with the formation of a clot in the stomach which apparently obstructed the gastro-enterostomy stoma until this was dislodged by stomach washing. After this the convalescence was smooth. He has remained well up to the present time.

In this case the second operation was ill-advised, giving ample opportunity for the re-activation of the original duodenal ulcer.

CASE 4. M. E., Hospital No. 280695, Hebrew, age 40, entered the hospital on the medical service April 23, 1915, complaining of dyspepsia of 5 years' standing. The X-ray showed some irregularity of filling of the duodenum. The test meal showed hydrochloric acid, 89. The diagnosis of hyperacidity was made. He was discharged to the Out-Patient Department for treatment. Three months later, in July, 1915, he re-entered the hospital on the surgical service with a perforating duodenal ulcer. He was immediately operated upon, a perforation of the first portion of the duodenum was closed by sutures and a posterior gastro-enterostomy done with linen sutures for the serous layer and chromic catgut for the inner layers. He made a good recovery and for 2 or 3 years felt very well. Then he began to have typical hunger pains which were at first relieved by soda and milk. He got along quite well by careful attention to diet until 4 weeks previous to his last entry to the hospital, when the pain became much more severe accompanied by frequent vomiting of dark material. He entered the hospital for the third time on December 22, 1926. The X-ray showed gastric retention. A small amount of barium could be seen to pass through the stoma. The findings were suggestive of jejunal ulcer. Upon operation a perforating gastrojejunal ulcer was found with its base formed by the mesocolon. A partial gastrectomy was done, the ulcer of the jejunum excised and a retrocolic end-to-side anastomosis performed. No signs of unabsorbable sutures were found at the stoma. There was some thickening and scarring in the region of the original duodenal ulcer. The patient made an uneventful immediate recovery.

CASE 5. St. O., Hospital No. 280100, Canadian-American, male, 46 years old, entered the hospital November 20, 1926, complaining of vomiting and a foul taste in the mouth. Seven years before admission he had a posterior gastro-enterostomy for duodenal ulcer performed at another hospital. He was completely relieved of his symptoms for over 3 years. He then had occasional attacks of pain and noticed tarry stools and vomiting of blood on one or two occasions. Four months before admission the pain ceased and he began to have marked diarrhœa with constant nausea and frequent vomiting of very foul material. Nineteen years previous to his admission he had appendectomy, 13 years previous, cholecystectomy. Test meal: free acid 70, total acid 90, guaiac negative. X-ray showed no 6-hour residue in the stomach. It emptied almost immediately through the gastro-enterostomy, so that neither the pyloric end of the stomach nor the duodenum could be well visualized. A barium enema showed that the colon filled normally as far as the middle third of the transverse colon. At this point the stomach, as well as the remainder of the colon, began to fill also. There appeared to be a small amount of small intestine connecting the stomach with the colon. Following the barium enema, air was forced into the colon, which was rapidly filled, the stomach was also distended by this air, and the patient began to belch. After the barium enema, 200 cubic centimeters of barium was washed from the stomach. The diagnosis of gastrojejunocolic fistula was complete. On November 25 he was operated upon. The stomach was found buried in adhesions which separated fairly easily. The portion of the stomach containing the fistula was freed. There was an opening admitting one finger from the stomach into the jejunum, and from the stomach into the colon. The colon and jejunum were freed from the stomach and from each other. Although the wall of the colon was considerably indurated there was no sign of an active ulcer either here or at the site of the stoma between the jejunum and the stomach. The opening in the colon was closed longitudinally causing some constriction of its lumen. The opening in the jejunum was closed transversely. The pyloric third of the stomach was then resected. There was definite evidence of an old ulcer in the second portion of the duodenum. The jejunum was united to the stomach by a retrocolic end-to-side anastomosis. A catheter was inserted into the transverse colon distal to the suture line with its end passing through the narrowed segment. Convalescence was complicated by a severe parotitis. He eventually recovered and left the hospital in excellent condition.

CASE 6. I. C. B., Hospital No. 280615, male, age 47, American, entered the hospital December 17, 1926. For 20 years he had suffered from dyspepsia with exacerbations and remissions, with severe hæmorrhages on several occasions. Nine years previously he was operated on at another hospital; the appendix was removed and something done to the stomach. Symptoms were relieved only temporarily and 8 years ago he had a posterior gastro-enterostomy with trans-section of pylorus for ulcer, at still another hospital. He got along very well for the next 8 years with only occasional slight attacks of gnawing pain and nausea which were relieved by bismuth powders until 10 days ago. Then he began to vomit dark blood and pass tarry stools. At admission he showed marked anæmia. After one week of rest in bed on a gastric diet he had a severe hæmorrhage. Transfusion was done, the hæmorrhage recurred 2 days later, transfusion was done again, and operation performed immediately. The red count fell to 2,240,000 and the hæmoglobin to 40 per cent at the lowest. At operation the stomach was found dilated, with marked adhesions in the region of the pylorus which had been divided at the previous operation. There was no sign of ulcer on the anterior surface of the stomach or along the lesser curvature. There was no induration to be felt in the region of the gastro-enterostomy stoma which readily admitted 3 fingers. The jejunum appeared normal. The colon was distended with blood. The first portion of the duodenum was distended, dark in color, and what seemed like an

ulcer on the posterior wall was palpated. The duodenum was opened but no ulcer was found. The stomach was then opened and the gastro-enterostomy stoma carefully inspected and found to be negative. After removal of a large quantity of clotted blood from the fundus of the stomach a large indurated ulcer on the posterior wall adherent to the pancreas was found. The base of this was lightly cauterized and the edges brought together with catgut sutures. After a stormy convalescence the patient slowly improved and was discharged from the hospital on February 13, 1927. Although there was no macroscopic postoperative bleeding, the guaiac test was positive on many occasions.

The surgical treatment of hæmorrhage from chronic peptic ulcer is a very perplexing problem. In this case the condition of the posterior wall of the stomach should have been investigated at once by opening the gastrohepatic omentum, the approach from below being shut off by the posterior gastro-enterostomy. The indurated ulcer of the posterior wall having been found, it should have been freed from the pancreas and either excised or destroyed by the cautery and sutured, or preferably a partial gastrectomy done if the patient's condition had warranted it, which in my opinion it did not in this case. The procedure adopted was merely palliative, and the only excuse for it was that so much time had been wasted in finding the lesion that it was not deemed safe to do anything more radical. In my opinion this man should return later for a partial gastrectomy.

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SPONTANEOUS PERIRENAL HÆMATOMA AND ANEURISM OF THE RENAL ARTERY

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WHEN as the result of any one of several causes retroperitoneal hæmorrhage in the vicinity of the kidney occurs, the escaped blood, on account of certain anatomical relationships, instead of being widely diffused, collects to form a localized hæmatoma generally spoken of as perirenal. The distinction is usually made in the literature between (a) aneurism[1] of the renal artery and (b) perirenal hæmatoma (used in a restricted sense), the latter term including all cases of perirenal bleeding other than those resulting from renal aneurism. This separation, though an arbitrary one, based upon tradition rather than clinical experience, is religiously adhered to by so many authors, that a review of the literature practically requires a consideration of the subject under two heads.

According to Conroy (4) 34 cases of aneurism of the renal artery and its branches were reported up to 1923. We have been able to gather 6 additional cases listed since 1923 and classified under the heading of aneurism of the renal artery, which brings the total up to 40. That this figure is hardly indicative of the actual number of renal aneurisms recorded is demonstrated by the fact that not one instance of periarteritis nodosa is included in this list of 40. Yet aneurisms on the basis of an arteritis of the nodular type have been repeatedly described (Gruber, 8) but have been classified for the most part under the title of the primary disease.

The cause of aneurism of the renal artery is trauma in over 50 per cent of the cases, the injury being either subcutaneous or perforative. An unrecognized aneurism due to a trauma dating back many years and perhaps long since forgotten may without apparent cause suddenly perforate and lead to fatal hæmorrhage. Spontaneous rupture is sometimes due to atheromatous or calcific changes in a sclerotic vessel. In such cases hypertension alone or hypertension plus nephritis is present. The aneurism formed is as a rule a false one. The tendency to produce aneurismal dilatations is a feature in that rare but exceedingly interesting disease, periarteritis nodosa, which although frequently generalized displays a particular affinity for the renal artery and its branches. Syphilis, by producing a gummatous arteritis, has also been reported as a cause of perirenal hæmorrhage. Emboli, especially of the mycotic type, may lead to miliary and larger aneurisms of the renal artery which may subsequently rupture in a manner similar to that occurring in cerebral vessels as a complication of subacute bacterial endocarditis. Low grade suppuration about the kidney pedicle appears to be responsible for erosion of the renal artery. In a case which came under our observation such an erosion led to sacculation and rupture. A unique case is described by Janssen (10) in which a sharp renal calculus led to erosion and aneurismal dilatation of an intrarenal vessel. Seven days after the removal of the stone through a nephrotomy, perforation occurred.

The symptoms as given by Israel (9), by which these ruptured aneurisms manifest themselves are usually *pain*, *hæmaturia*, and *tumor formation* in the loin. The pain is usually of a severe type, sudden in its onset, referred to the kidney region, and radiates at times down to the groin or up to the shoulder. The duration of the pain varies between wide limits, recurrent attacks in the non-operative cases being a frequent occurrence. These periodic attacks of pain are presum-

[1] The term aneurism throughout the article is used to include both true and false types.

ably simultaneous with recurrent hæmorrhages. Hæmaturia occurs in practically half of the cases, being particularly profuse in those instances in which the aneurism perforates into the kidney pelvis. Repeated attacks of hæmaturia are explicable on the same basis as the periodic attacks of pain. The tumor of the loin may assume small or large proportions and, depending upon the rate of escape of blood from the ruptured artery, the tumor may enlarge imperceptibly or with surprising rapidity. On account of the small caliber of the renal artery a sacculation of a portion of it hardly reaches sufficient size before rupture to give the usual pathognomonic physical findings of aneurism. Thus expansile pulsation, palpable thrill, and audible bruit are only very occasionally reported. In one case a systolic murmur was heard over the region of the tumor. Tenderness is variable, being elicited as a rule, however, when the hæmatoma ruptures into the peritoneal cavity or peritonitis is present. Not infrequently vomiting, usually of a reflex nature, is a prominent symptom. Tympanites is a common occurrence tending to obscure the physical findings and leading in some cases to the suspicion of an acute surgical condition of the abdomen.

In the 29 cases he collected until the year 1922 Vogeler (17) found that diagnosis of aneurism of the renal artery was made preoperatively or antemortem in only 5 instances. In 1 case mentioned by Vogeler, that of Armstrong (1), there was apparently an error in translation for according to the original article hæmorrhage was not suspected clinically, the diagnosis of tumor of the right kidney being made. In the other 4 instances to which Vogeler referred, so far as could be ascertained, a very definite history of trauma antedated the onset of symptoms. It is quite apparent, therefore, that in the absence of the knowledge of an injury the diagnosis of a renal aneurism is seldom made.

Of the same 29 cases referred to, 4 were incidental findings at postmortem, while the remainder gave the train of symptoms mentioned above. Of the 25 clinical cases, 7 came to operation, 6 of which recovered. Of the 18 nonoperative cases, all ended fatally. The duration of the illness was from 2 days to 14 years, 11 patients dying within the first year. In 1 case Orth (14) sutured a tear, the result of a stab wound of the renal artery, whereas in the remainder of the operative cases nephrectomy was resorted to.

Perirenal hæmorrhage having an etiology other than aneurism of the renal artery or its branches, was according to Sohn (16) first mentioned by Raye in 1839, but the condition was not fully described until 1846, when Wunderlich (18), in his *Handbook of Pathology and Therapy*, described in connection with affections of the kidney bed, a rare disease characterized by massive hæmorrhage and termed it "Apoplexie des Nierenlagers." Subsequent reports dealing with hæmorrhage about the kidney from a variety of causes other than aneurism have been classified as perirenal hæmatoma, of which in 1910 Coenen (3) was able to collect 16 cases (including 3 instances of the so-called perirenal hygroma). The literature until 1921 was splendidly summarized by Sohn (16), and more recently by Greco (7), who succeeded in gathering 62 cases a few of which, however, could more appropriately be included under aneurism of the renal artery.

The distinction is usually made anatomically of hæmorrhage (a) between the kidney and its true capsule, (b) between the layers of the fibrous capsule, and (c) in the fatty tissue about the kidney. One can therefore distinguish (a) subcapsular, (b) intracapsular, and (c) extracapsular forms, although it is to be borne in mind that combination forms are frequent. Clinically, however, the differentiation is most difficult and at times impossible.

Aside from lesions of the renal artery and its main branches, causes of perirenal hæmatoma may be divided for purposes of classification into (a) disease of the kidney parenchyma and smaller renal vessels, (b) primary hæmorrhage from the fibrous or fatty capsule of the kidney, (c) morbid processes of retroperitoneal structures other than the kidney or its capsule, and (d) blood dyscrasias. In the first group, that is, in diseases of the kidney itself, the hæmorrhage at the outset is manifestly subcapsular, but as the retained blood increases in amount, rupture of the

distended capsule occurs, and extension into the perinephritic tissues follows.

Perirenal hæmorrhages arising from the renal parenchyma are described as a result of a variety of tumors including hypernephroma, carcinoma, sarcoma, and multiple cavernomata. Renal tuberculosis may cause hæmorrhage into and about the kidney in a manner similar to that in which pulmonary tuberculosis produces bleeding in the lung and air passages. Purulent processes within the kidney may lead to perirenal hæmorrhage either as a result of an ascending infection or following the lodgment of an infected embolus with the subsequent formation of a metastatic pyæmic abscess. One of us (13) in 1919 reported a case in which the perineal hæmorrhage was the result of ascending infection. Secondary suppuration presumably of hæmatogenous origin in the presence of polycystic disease has been found associated with perirenal hæmorrhage. What has been said concerning the etiology of aneurisms in general applies to affections of the smaller blood vessels. Such factors as nephritis, nephrolithiasis, hydronephrosis, and polycystic disease have been wrongly considered the sole cause of perirenal hæmorrhage. However, in these cases one must assume the presence of another factor such as an abnormal fragility of the vessels or a blood dyscrasia; otherwise it would be difficult to account for the rarity of perirenal hæmatoma as compared with the frequency of nephritis for instance.

Most puzzling are the cases of so-called primary or essential perirenal hæmatoma that are exclusively intracapsular or extracapsular. In these cases the hæmorrhage has its origin entirely outside of the kidney, the capsule throughout its extent being intact. The explanation of recurrent capsular bleeding offered by Coenen (3), that is, the presence of a hæmorrhagic perinephritis, finds its analogy in a hæmorrhagic pachymeningitis and is supported by microscopic evidence. Wunderlich (18), in his classical description of the condition published in 1846 called attention to the perinephritis which supervened upon inflammation of the kidney and its pelvis. Evidence has been adduced in support of the contention that the inflammation can by further extension involve the fatty capsule, and as a result of tears in the delicate granulations eventuate in threatening extrarenal hæmorrhage. Other hypotheses for the origin of the escape of blood into the kidney capsule have been suggested including a complicated vasomotor disturbance promulgated by Ricker (15). The occurrence of capsular hæmorrhage in the presence of a hydronephrosis led Baggerd (2) to associate the two, ascribing the hæmorrhage to the vascular changes induced by the compression.

The next group of causes comprising lesions other than those involving the kidney or its capsule include aneurism of the abdominal aorta and of the ovarian artery, hæmorrhages from the adrenal gland, and from retroperitoneal tumors such as angiosarcomata. In 1925 a patient at the Cook County Hospital was transferred to the Urological Service on account of a tumor of the loin which suggested the presence of hydronephrosis. At operation a perirenal hæmatoma was found and packing resorted to. The autopsy disclosed an aneurism involving the abdominal aorta which had eroded the spine and ruptured, a massive accumulation of blood in the right loin resulting.

Hæmophilia is the most important representative of group (d), namely, the blood dyscrasias. The hæmorrhage arises frequently from the lumbar muscles and from the standpoint of source of origin might be included under the morbid processes of retroperitoneal structures other than the kidney or its capsule. The loss of blood in this group is by diapedesis but nevertheless as will be seen later may be quite alarming.

The symptoms associated with the non-aneurismal group of perirenal hæmatomata are summarized by Lenk (12) in the form of a triad, namely, severe pain, signs of internal hæmorrhage, and a rapidly growing retroperitoneal tumor in the loin. The severity of the pain at the outset may be of sufficient degree to produce unconsciousness so that when the pain is associated with anuria, uræmia may be suspected. Repeated attacks of pain due to recurrences of the hæmorrhage may be present as in aneurism of the renal artery. The evidences of internal hæmor-

rhage are obviously dependent upon the amount of blood lost, the degree of anæmia being as a rule directly proportional to the size of the hæmatoma. Hæmaturia of the severe grade frequently associated with aneurism is not described in this group, otherwise the remaining symptoms are quite similar.

It would appear that in those cases in which the cardinal symptoms were manifested (severe initial pain, signs of internal hæmorrhage and a rapidly enlarging tumor in the loin) the presence of a perirenal hæmatoma would be readily suspected. However, according to Sohn (16), who reviewed the literature until 1921, only 3 cases up to that time were correctly diagnosed clinically (Doll, 5, 1907; Ricker, 15, 1911; Laewen 11, 1912). It is noteworthy that in all three instances these clinicians had had under their care previously one or more similar cases.

It is the consensus of opinion that the prognosis depends entirely upon the treatment, conservative handling resulting almost invariably in a fatal outcome, whereas operation carries with it a mortality of approximately 60 per cent.

In order to make the picture of perirenal hæmorrhage clear and to impress upon the minds of the readers the clinical manifestations of the condition, we can do no better than to relate a case which we recently were fortunate enough to diagnose and subsequently cure through operation.

CASE REPORT

M. H., a white female, 46 years of age, was admitted to the medical service of Dr. W. Quigley at the Cook County Hospital, August 22, 1926, at midnight, complaining of severe abdominal pain and persistent vomiting, both symptoms having been constantly present for the past 7 days. Two previous similar attacks, neither as severe nor as prolonged, were suffered during the 2 months preceding her entrance into the hospital. The pain which was sharp and stabbing, located in the right loin, passing at times to the right upper quadrant, was relieved only by a hypodermic of morphine. The patient's statement concerning her frequency of vomiting (every few minutes) was evidenced by her almost continuous retching; but in spite of her inability to retain food obstipation was absent. She had noticed for a week the presence of a mass in the right side of the abdomen without any increase in size. No other information was obtained except perhaps that she was assaulted 7 years previously and suffered a scalp laceration then as a result of a blow on the head.

Physical examination disclosed a rather poorly nourished and developed white female, who moaned incessantly and was apparently suffering acute pain. Retching and the emesis of a bile stained thin fluid frequently interrupted the groaning. The forehead was covered with large beads of perspiration, obviously not the result of the atmospheric temperature for the room was comfortably cool. The only noteworthy finding was the presence of an abdominal mass the size of a lemon located to the right and slightly above the level of the umbilicus, firm, elastic, smooth, only very slightly tender, having no respiratory mobility. Bimanual palpation of the right loin furnished the impression that the tumor mass lay anterior to the kidney. Ventral pressure caused a smooth structure (posterior kidney surface) to come in contact with the inferior palpating hand. The examination was facilitated by the thin abdominal wall and the absence of distention, rigidity, or marked tenderness.

The blood pressure was 130 millimeters systolic, and 90 millimeters diastolic. The entrance temperature was 99 degrees F., the pulse rate 86, and respiratory rate 24 per minute. The white blood count was 11,400 of which 82 per cent were polymorphonuclear leucocytes. The hæmoglobin reading was 75 per cent while the erythrocytes numbered 3,750,000. In the urinary sediment no abnormal constituents were found. The following day the patient was examined and the conclusion reached that the symptoms were due to a hæmorrhage either intraperitoneal or extraperitoneal, or to the twisting of an abdominal tumor or viscus upon its pedicle. The condition was looked upon as surgical but before consultation was sought, cystoscopic examination was done to ascertain the functional capacity of the left kidney, in the event that at operation the question of a right nephrectomy should arise. Cystoscopic examination by Dr. H. Katz, undertaken the following morning, yielded the findings of a normally functioning left kidney and an obstructed ureter on the right side, which obstruction could readily be overcome, since the injection of 5 cubic centimeter amounts of water into the ureteral catheter produced a return flow of 4 or 5 drops of urine, colored by the test dye injected intravenously.

It was apparent that the abdominal mass was steadily increasing in size, having acquired twice its original proportions within the 24 hours following admission. On the basis of the rapid enlargement of the tumor mass, it seemed reasonable to assume the presence of the already suspected hæmorrhage. Although the mass was situated anteriorly, so that inspection of the abdomen with the patient in the recumbent position revealed a projection above the surface of the ventral abdominal wall, the tumor was considered to be of retroperitoneal origin, since it was well circumscribed and well demarcated in contradistinction to intra-abdominal hæmorrhages which are as a rule diffuse and difficult to outline.

The findings resembling closely those previously seen in cases of hæmorrhage about the kidney, the diagnosis of perirenal hæmorrhage compressing the right ureter readily suggested itself. The patient was interrogated again relevant to the possibility of trauma to the loin but could recall no injury to this region. Arterial disease could not be demonstrated for the peripheral vessels were normal in consistency, the Wassermann was negative, no signs of periarteritis were exhibited involving the superficial vessels, nor could an increased fragility of the finer radicles of the skin of the arms be elicited. No evidence of a blood dyscrasia was demonstrable for the bleeding and clotting times respectively were normal and the number of platelets estimated in the blood smear was increased rather than decreased. Signs and symptoms of a suppurative process or a history thereof were likewise lacking. The patient was sent to operation with the diagnosis of perirenal hæmatoma of undetermined origin.

Local anæsthesia was used because the condition of the patient was such that prolonged general anæsthesia was not advisable. Through an S-shaped kidney incision a mass of clotted blood located especially anterior to the kidney was exposed. In an attempt to discover the source of the hæmorrhage it was necessary for purposes of exposure to remove portions of the hæmatoma that were somewhat firm and adherent with the result that the patient complained bitterly and the administration of a gas anæsthetic was instituted at this point. Upon exposing the pedicle of the kidney there was encountered in the proximal portion of the anterior surface of the renal artery a perforation from which a jet of blood escaped with each cardiac pulsation. The demonstration of this lesion to the satisfaction of the physicians present was hardly completed when the patient's condition became precarious and it was necessary to clamp the bleeder and institute measures of stimulation and fluid replacement. Unfortunately the proximity of the location of the perforation to the point of origin of the renal artery precluded the possibility of applying a clamp proximal to the site of the lesion. The kidney was removed without further delay in the usual manner and two iodoform drains inserted. The convalescence through the aid perhaps of several saline transfusions and one blood transfusion was rather uneventful although for a time the prognosis seemed grave. During the postoperative course, a considerable amount of a purulent material was discharged from the wound, which on smear showed in addition to pus cells the presence of cocci in chains and clusters.

Grossly the extirpated kidney presented no noteworthy alterations except for the presence of clotted blood covering its surface. In the hilus the clots were white and somewhat firm, elsewhere dark red. For the most part the hæmatoma was rather intimately adherent to the kidney capsule (Fig. 1). The renal artery together with its main branches except for a few raised yellow plaques was unchanged. At the lower pole the veins were occluded by recent thrombi, apparently due to stasis, the result of external pressure exerted by the extravasated blood. The fibrous capsule was intact and the kidney parenchyma normal in all respects. Microscopically, except for a patchy intimal thickening of slight degree no remarkable changes were present in the main renal artery or its branches (it is to be remembered that for reasons already stated the renal artery was divided distal to the point of rupture). In the fat of the hilus, however, a clue to the origin of the perforation was found. Infiltrating the fatty areolar tissue are found inflammatory cells and fibrin but no evidence of either recent or old hæmorrhage in the form of blood or blood pigment. In passing from this zone of inflammatory exudation, one finds a proliferation of fibroblasts and the presence of many newly formed vessels (Fig. 2). The vascular elements consist of spaces lined by endothelium about the majority of which a deposit of material of varying thickness undergoing fibrinoid necrosis is found.[1] On the basis of the data available, it appears that a focus of suppuration of undetermined origin located at the root of the kidney led to an erosion of the renal artery and the formation of an aneurismal dilatation with subsequent rupture.[2] The changes in the fat about the hilus as well as the profuse purulent discharge from the operative wound are attributable so far as can be ascertained to a cryptic infection about the kidney pedicle.

Our experience with 4 cases has taught us to look upon spontaneous perirenal hæmatoma (in a broad sense) as a definite entity demanding as a general rule immediate surgical intervention. The symptoms which characterize this affection, irrespective of the etiology are pain of a severe type, signs of internal hæmorrhage, formation of a perceptibly enlarging tumor mass in the loin, and at times hæmaturia and signs of peritoneal irritation. From a consideration of these cardinal symptoms alone, it is frequently impossible to diagnose the primary cause of the hæmorrhage for as a rule the severity of the pain is independent of the mode of escape of blood and curiously enough, the pain is frequently of equal intensity in hæmorrhage by diapedesis or by rhexis. As a matter of fact capillary oozing in primary hæmorrhage of the fatty capsule of the kidney is associated at times with more exquisite pain than rupture of the main renal vessel. The signs of internal hæmorrhage occur likewise irrespective of the caliber of

[1] A more complete histological study will be published elsewhere.

[2] This interpretation was suggested independently by E. R. LeCount and R. H. Jaffe from an examination of the microscopic preparations.

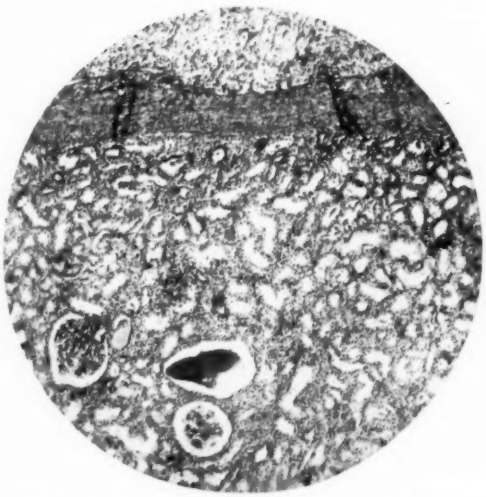

Fig. 1. Section taken from the renal convexity showing the relationship of the early organizing blood clot to the greatly thickened fibrous capsule of the kidney. The vascular elements in the clot are all of the capillary type. A small cyst with hyaline contents is seen within the kidney parenchyma. (× 65.)

Fig. 2. Section from the tissue about the kidney pedicle. The normal loose fat is almost entirely replaced by granulation tissue rich in blood vessels the walls of which show a wide variation in thickness. Those vessels which have greatly thickened walls are for the most part in a state of fibrinoid necrosis. (× 65.)

the vessel involved, for it has been repeatedly observed that rapidly developing anæmia is just as likely to occur when a bleeding point is too small to be demonstrable as when aneurisms of the renal artery are largest. The tumor mass in the loin, the result of an accumulation of blood in an anatomical bed when the patient assumes a recumbent position, can reach just as large proportions in primary hæmorrhage of the capsule as it can in aneurisms of the renal artery. The occurrence of hæmaturia, although far more frequently associated with perforation of the renal artery is not invariably present in this condition, whereas primary extracapsular hæmorrhage may be associated with independent hæmorrhage into the pelvis and hæmaturia (Baggerd, 2). Evidences of peritoneal irritation are conditional upon factors other than the point of origin of the hæmorrhage; for the tenderness, rigidity, and meteorism encountered in perirenal bleeding may be due to any one of a number of causes.

The separation of renal aneurisms from all other causes of perirenal hæmatoma is bewildering to the clinician and therefore unjustifiable. The term perirenal hæmatoma should be employed by clinicians as well as pathologists (Fahr, 6) in a broad sense to cover all conditions leading to the production of an accumulation of blood in the loin. Aneurism of the renal artery would then be only one of the causes of circumrenal bleeding and unless the history or concomitant manifestations point to a definite causal factor, the diagnosis of perirenal hæmatoma of unknown etiology should suffice.

We are disposed to look upon perirenal hæmatoma as we do upon intestinal obstruction. The diagnosis of mechanical bowel obstruction being established, the indication for operation is usually clear. The pre-operative knowledge of the etiology though highly desirable is not essential in the decision as to the type of management, whether medical or surgical, to be followed; and the presence of a perirenal hæmatoma being established, whether or not the cause is known, the case with few exceptions becomes a surgical one.

It is noteworthy that in all 4 cases of spontaneous perirenal hæmatoma in which the preoperative diagnosis was correctly made, the

examining clinician had had the opportunity of dealing with a similar case previously. It is apparent, therefore, that the almost universal failure to diagnose correctly cases of spontaneous perirenal hæmorrhage is attributable in a great measure to the lack of acquaintanceship with the clinical picture produced by the condition. It is hoped that the acceptance of the conception that perirenal hæmatoma is an affection characterized by definite symptoms (severe pain, signs of internal hæmorrhage, a rapidly increasing tumor of the loin with at times signs of peritoneal irritation and hæmaturia) will lead to a more frequent *intra vitam* recognition of the disease. It is furthermore hoped that the adoption of the viewpoint by both internists and surgeons that the diagnosis of perirenal hæmatoma calls for immediate surgical intervention (even though the etiology preoperatively be obscure) will result in timely operative treatment in a greater number of cases.

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ARTIFICIAL IMPACTION IN HIP FRACTURES

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ARTIFICIAL impaction at the hip, proposed and carried out by me in 1908, and consistently used since then, means the operative production of an impaction comparable to the best accidental impaction. Such impaction is produced only after accurate reduction of fragments.

Impaction is not in itself a complete method of treatment but the step that happily initiates treatment, that enables us to secure a functioning hip. I have used the method many times and believe in it. Before going into the reasons why, certain points must be made clear.

Only because there seems to be, even today, a world of confusion as to the classification of hip fractures, should one spend time in the discussion of their classification or dwell on the importance of keeping the distinction of the established classes clean-cut and clear. Some time ago Sir Astley Cooper made all this clear, but we have forgotten his teachings; indeed, until very lately at least, we have entirely forgotten.

There are three classes of hip fractures and only three: (1) extracapsular fractures, not impacted; (2) intracapsular fractures, impacted well or ill, or not at all; and (3) epiphyseal separations, endocrine or really traumatic, in essential causation.

Most writers and most players of special "systems" have confused classes 1 and 2, and have, therefore, had and claimed results that are difficult of analysis because of this utter confusion between the one class that cannot help but give bony union and the other class that can at best be coaxed into uniting by bone only in a percentage of cases, which until very lately was very low. The epiphyseal separations are not fractures at all, and I shall not discuss them in detail now. Whitman published an admirable and conclusive series of articles on the treatment of such cases years ago.

Intermediate cases no doubt occur but they are very rare and belong essentially in class 2. Accordingly we have to consider: (1) extracapsular fractures, the trochanteric, pertrochanteric, or intratrochanteric fractures which are indeed all one thing (Fig. 1)[1] and (2) intracapsular or subcapital fractures (Figs. 2 and 3).

EXTRACAPSULAR FRACTURES

In extracapsular fractures the lesion varies in different cases. Figure 1 shows the common type. The class 1, extracapsular, fractures, occur at any age—my youngest patient was 4 years of age, my oldest 89. They are the result of the same trauma, a sideways fall on the buttock, that produces most of the hip fractures. Here and there is a case, usually that of a young man, who has suffered the lesion after a severe fall on the side. Clinical diagnosis based on the history, age, and clinical examination of the patient has failed me too often. At best it is a guess. Either type may be present at any age, in any case. The X-ray is the only sure method of making a diagnosis.

Given a fracture which has been diagnosed as of the extracapsular type, we know we shall get union by bone, in spite of every failure in skill of treatment. The problem is, very simply, the avoiding of deformity, including shortening, and the minimizing of the loss of motion at the hip. Consideration of these matters need not delay us long for the mechanical problem presented is simple. There is no place for artificial impaction in this class. The whole aim of treatment is to correct coxa vara displacement, to guard against its recurrence, to avoid the establishment of any contracture of adductors, to correct outward rotation and to keep it corrected, and to institute motion as early as is safe.

The logical treatment in this class is the Phillips-Maxwell-Ruth scheme of longitudinal traction, combined with lateral (outward) traction, applied close up to the crotch. This treatment works out very well, and I have used it with success.

[1] The separate splitting off of the lesser trochanter, which is the usual happening, seems of no clinical importance. Impaction, that is real impaction, is rare.

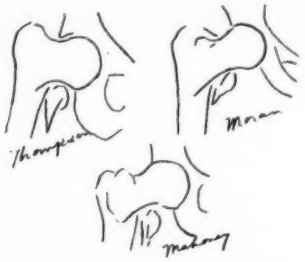


Fig. 1. Showing the common types of extracapsular fracture.

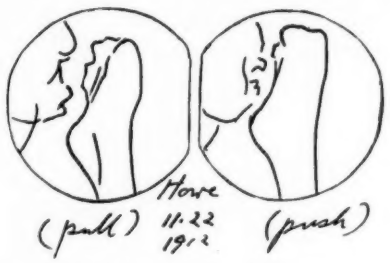


Fig. 2. Intracapsular fracture—absorption under routine treatment. Unfortunate result.

A like result may be obtained by abduction in plaster, but with this procedure there is a chance that the bone may slip or may go into a coxa vara position. Therefore, if one elects this method, frequent X-ray examination should be made to check up the progress.

The remaining method, the one I prefer to use, is that of traction with the limb in abduction. The angle of abduction should be about 25 degrees, the weight applied 10 to 20 pounds.

There is no advantage in this method over that of longitudinal and lateral traction save that it is more nearly fool-proof and avoids the possibility of interfering with the circulation, which even Osgood's ingenious "binder's board" collar about the thigh does not quite eliminate if lateral traction is used. May one say, however, that the results are just as good by my method? There is in this class abundance of nutrition, and prompt repair with callus. Union is firm at 6 weeks, is solid at 8 as a rule, the limb can bear a bit of weight at 10 weeks, and is quite strong at 12 weeks. The patient is able to go to work in from 18 to 20 weeks. Usually movements may be begun in 7 to 8 weeks. As a rule no convalescent splint is needed. Usually the terminal damage is confined to some loss of motion at the joint with perhaps a half-inch of shortening, which is of no consequence if adductor contracture has been avoided. Bony union occurs always.[1]

Extracapsular fractures present no serious problem and should be kept distinct from the intracapsular fractures.

INTRACAPSULAR FRACTURES

Intracapsular fractures, otherwise called subcapital fractures, or high fractures of the neck, are the real source of trouble. These, and these only, give the loose, sloshing, useless hips so well known, that are still so common, so calamitous, and so little a credit to our profession. The lesion in these cases is typical. They result from various falls or most often from just sitting down sideways on the street or on the house floor. They most commonly occur in clumsy old folk who tumble down in a lax fashion. The ratio as to sex is 8 or 9 women to every man. They are found not rarely in middle aged folk and sometimes in the young. There is no real or serviceable age differentiation as concerns the intracapsular and the extracapsular fractures. The differential diagnosis cannot be made[2] without the aid of the X-ray.

Some such fractures are loose from the beginning, some loosen up, some are impacted and remain so. The degree of impaction, if present, varies. One sees types A (Figs. 26, 34, and 37), type B (Fig. 3), and Type C (Fig. 4), and of these, unfortunately, type C is commonest. while type D (Fig. 5), the same save for grotesque outward rotation,[3] is not rare.

Type A is the loose, unimpacted fracture which fails to unite unless reduced and impacted or very firmly held.

Type B is apt to do well under any treatment, sometimes with none, and type C may do as well, though impaction is poor mechanically, poor for repair.

[1] I know of one doubtful case of Dr. J. B. Murphy's of non-union or delayed union; of one non-union cured promptly by 606; of one delayed union in a small boy, cause unknown; and no others.

[2] I think one can guess right three times in four but that is not diagnosis

[3] Known in the X-ray plate by the conspicuous profile of the lesser trochanter, normally posterior but rotating forward as the limb rolls out.

Fig. 3. Accidental impaction: broad surfaces opposed, impaction seemingly very deep. This patient though nearly 70 years old, recovered with a perfectly useful hip.

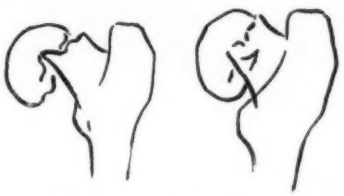


Fig. 4 (left). False impaction—merely a spiking of the loose head by the spur left on the lower side of the neck. Very little mechanical stability. Very little surface o bone opposed for repair. This is the commonest type; is apt to come apart and fail to unite. It should be reduced and impacted.

Fig. 5. No better than the last, mechanically, and considered with regard to the chance of useful repair. Moreover, the outward rotation is so great that there would be disability from it even with the bone solid. Such an impaction calls without question for remodeling and reimpaction.

Either type may, however, fall apart under the normal absorption process which is to be taken up presently, and types C and D do so rather commonly.

The fact is, however, that under usual routine treatment the loose fractures stay loose; the poor impactions usually loosen up; and only the firm impactions get bony union.

Moved by the depressing findings in a review of the end-results shown in a follow-up of hospital cases, I conceived, many years ago,[1] the scheme of artificial impaction, of impaction produced by driving the fragments together so as to imitate the condition of favorable impaction that is occasionally created by the chance of the fall. There seemed nothing to lose in the loose cases, nothing worth counting a loss in reducing the unfavorable cases into favorable position, and then impacting them.

The method used was, then as now, a reduction by dragging the leg down (with counter-pressure by the stockinged heel in the crotch) to equal length with the other leg, to exact correction, as near as may be. Then the leg is carried into moderate abduction and into sharp internal rotation, and held there, while a strong assistant steadies the pelvis.

A big wooden mallet—mine is of lignum vitæ—originally of about 7 pounds weight[2] is used to impact the break. Impaction is by a succession of slow swings—"following" blows on the felt-protected trochanter. Presently a queer sensation of "giving" is felt, and then a test shows the limb locked, toes standing up like those of a real leg. The limb no longer rolls loosely outward in one's hand! That is all! There is no damage, not even superficial bruising. Impaction is probably never very deep, but it serves to hold position. The whole idea is to convert unfavorable into favorable types of fracture in shape for treatment.

In no sense can artificial impaction do more than this! In any case after-treatment is the same as that used in the most favorable type of accidental impactions. That means rest—fixation.

I can accomplish this best with the double plaster spica, with a crossbar,[3] that makes it possible to obtain fixation with a spica that may be cut away low down on the back and belly, for the double abduction gives through abduction of the sound thigh, a fixation of the pelvis in relation to the damaged femur, and fixation of the trunk is not needed (Fig. 8). Moreover, this type of spica makes it possible to roll the patient on her face an hour a day without damage, which helps lungs, circulation, and temper, and renders bed sores avoidable.

This fixation should be kept up from 10 to

[1] Cotton. Am. J. Orthop. Surg., 1911, viii, 680-686.

[2] Drying out with the years has brought it to about 5 pounds today.

[3] The single spica is fine at first while it fits. As the padding and the patient shrink, there is considerable play and unless the spica is high and close enough to interfere with chest and abdomen, fixation is no longer maintained.

12 weeks which is a safe average.[1] At the end of this time in some patients, usually the younger and more vigorous, we find by X-ray examination a union so solid that the patients are able to get along nicely with crutches only, provided they are reasonably cautious.

This is not the rule, however; usually a convalescent splint is in order. The reason for this is not only that repair is slow but also that there is interstitial absorption as noted above. This phenomenon occurs in most cases, is more marked in the older people, but is not peculiar to them. It seems akin to the softening in the cortical edges in lower leg fractures, preceding or coincident with repair. As a matter of fact, whatever the treatment or non-treatment, this absorptive process goes on, normally, preceding or parallel with the repair process.

At the hip, absorption takes place at the expense of the living, distal fragment which is supplied with blood and with nerve impulse which have been cut off from the broken-off, and so to speak, deserted proximal fragment within the capsule. Very often this absorption is extreme, even in cases which ultimately unite by bone. Evident at 4 weeks, at its maximum usually at 6 weeks, persistent for months thereafter particularly in the aged patients, this process seems a part of normal repair. (See Figs. 24, 25, 37, 38, 39, 40, 41, 42, 43, 44, 45.)

As a corollary of this presentation, one must include a curious picture, of slow repair, after gradual or abrupt partial separation at the upper side of the line of fracture. (See Figs. 10, 32, 33, 34, 36.) All these cases were carefully treated, but all, for no evident reason, showed a tendency to fall apart. None of them were even elderly patients, none were infirm. All, protected, achieved bony union late or later.

One case, a young man, "fell apart" entirely after 4 months' treatment by the Whitman method. After reduction, reimpaction, fixation, and later proper protection, bony union was secured and the clinical result was marvelously good—100 per cent by any measure.

Until recently this matter of absorption seems to have been overlooked by me as well as by others. We cannot control it directly, though I think that diathermy is of real use as I reported 2 years ago.[2]

With or without diathermy, one may achieve results by protection. In a case which shows absorption, one fits a convalescent Thomas splint to the limb, and then waits until the X-ray shows that the splints may be discarded without risk.

Figure 19 shows a patient who waited 14 months for a serviceable hip and got an admirable result. Figure 33 shows a patient who waited 15 months and secured a 100 per cent perfect result. In Figure 31 we see bony union which was obtained after protection for over a year and a quarter. The patient in Figure 44 wore the splint for just a year and now has, at 86 years, a serviceable walking leg. Another patient after 18 months has a clinically perfectly good hip with full function. In this case the union is by a short fibrous bond, not by bone, but it works. Another patient, protected for 8 months has a serviceable hip, solid, with fair motion, no pain. The union is not bony. Whether it may become bony or not I am not sure. She is nearly 80 years old, though vigorous.

The moral is to use protection, and to use it for months. That means a convalescent Thomas caliper splint by day, sandbags by night, with massage and conservative passive motion to hip and knee at the morning and evening intervals.

A chair to push before one, or crutches, should be used at first. Later, a cane, or none, should be used, for the splint, properly adjusted, seems to be a definite protection against displacement.

When the X-ray shows that union is solid, bone solid, then the splint is removed.

The broad fact seems to be that if we correct, fix, and maintain in favorable position, any fracture within the capsule, whether originally or artificially impacted, maintain it until the X-ray shows satisfactory repair, then we are going to get a solid union, bony more often than not, but serviceable in any case.

[1] Provided this is tolerated by the patient. Most patients do well, better and more comfortably in such a spica than if neglected under the excuse so often heard, of "treating the patient rather than the fracture," but of course there is room here for judgment.

[2] Tr. New England Surg. Ass., 1924.

Fig. 6 (left). X-ray of case impacted for Dr. Kellogg Speed, Cook County Hospital, Chicago, January 15, 1927, before reduction.

Fig. 7. Same case as in Figure 6 through the plaster, after reduction and artificial impaction with the mallet.

A certain mortality we cannot avoid, for most of the patients who have these injuries are infirm, elderly women. For like reasons we cannot avoid a certain proportion of arthritic complications, whether injury is in the hip or the knee.

What we can avoid is that ghastly class of "wheel-chair invalids" with loose, sloshing non-unions, unstable, and very painful, which have been the usual net result of hip fracture treatment throughout the country. We have all seen them!

And how may we avoid such results? In cases satisfactorily impacted, when we first see them, and there are only a few of them, we put up the limb and the patient in a double spica with a cross-bar (Fig. 8).

In this arrangement the patient can be turned over at least once a day, without pain and without damage. After 3 months this apparatus is exchanged for a carefully fitted Thomas caliper splint of the convalescent type, and the patient gets up, tries crutches, or gets about with a chair. From then on he uses the limb with caution and mobilization is allowed at hip and knee. Only the X-ray can tell us when to discard the protective splint. This is the treatment for the "ideal" (rare) case. For the less fortunate average case, one approximates this treatment artificially. The loose fracture must be corrected.

Under anæsthesia,[1] downward traction with the surgeon's stockinged heel is applied in the crotch until the length of the

[1] Not for 5 days in older patients. Heart, lungs, bowels, bladder are upset and at least this long is required for the patient to recover from the shock, and to adjust her bodily processes to a bed routine. This delay does not help the fracture, but is essential to the patient.

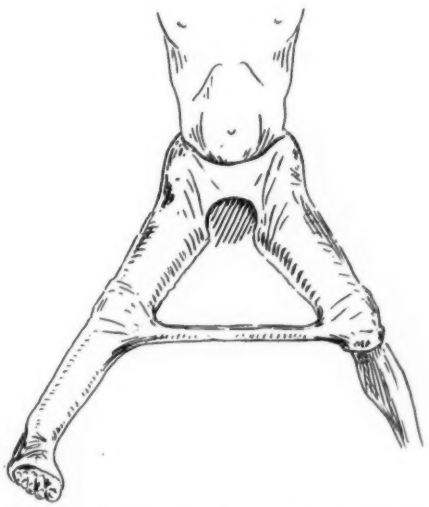


Fig. 8. The double spica. The important thing is the cross bar of plaster, 1½ to 2 inches in diameter, solid enough to handle the patient, fracture plaster and all. Abduction of both thighs, internal rotation on the damaged side. Note the amount of freedom given to the abdomen as well as the chest.

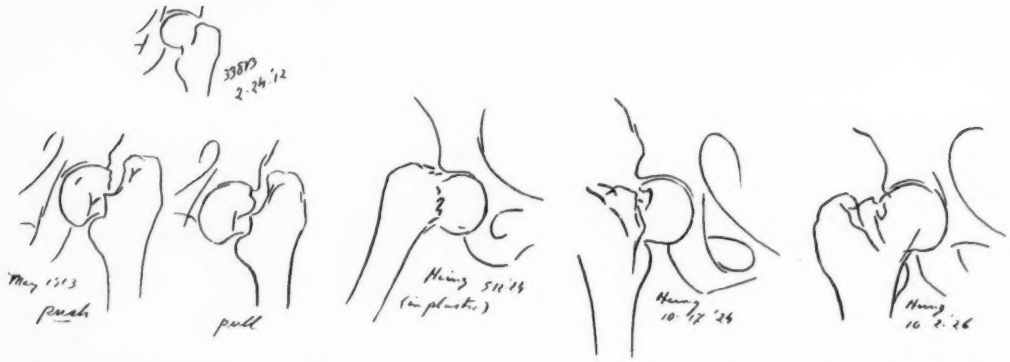


Fig. 9. The absorption process. This patient left the hospital at 6 weeks, apparently with solid union (X-ray, February 24, 1912). Fifteen months later when I first got hold of him, the condition was that of the "push and pull" pictures of May, 1913—a loose non-union with hardly a trace left of the neck.

Fig. 10. Partial absorption, slow union. A woman of 44 and vigorous. After reduction of a loose fracture and the usual impaction, the condition looked favorable (see X-ray of May 12, 1924). The spica was kept on 3 months: she was out of bed at 4 months, on crutches and beginning to walk. An X-ray at 5 months taken as a routine showed the findings of the central tracing. Immediately, I put on a convalescent Thomas caliper splint, and there was no increase in the beginning separation at the upper edge. She walked about on this splint, actively, without crutches, but it was late in the summer of 1925 before I dared let her step without support. In the end the bone is solid (see the X-ray of October 2, 1926) and function practically perfect.

limbs matches, right and left. Then the leg is carried into moderate abduction, the limb is rotated inward, while a stout assistant holds the pelvis steady from the opposite side. The operator using a big, heavy, wooden mallet (5 to 8 pounds) strikes the padded trochanter a heavy, slow, "following" blow inward. This is repeated until the foot no longer rolls outward, and impaction is obvious.

Then conditions are the same as if there had been in the first place an accidental impaction in good relation of fragments.

But if impaction is doubtful, when the case is first seen, what then? An impaction as in

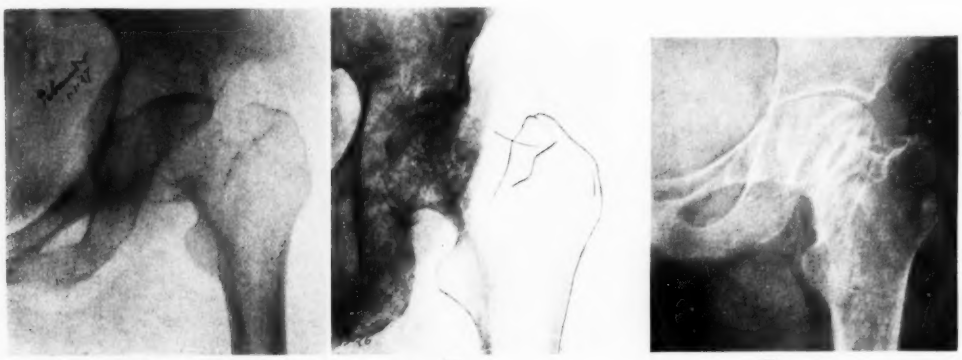


Fig. 11. Fig. 12. Fig. 13.

Fig. 11. Union solid in 4 months in a woman of 68. A fortunate case of deep accidental impaction properly cared for. At the time of this X-ray she was walking without a cane.

Fig. 12. A like case in a woman of 67. Impaction so exact that I did nothing but carry out routine fixation in spica, etc. No convalescent splint was used. Function perfect 1½ years later when this film was taken. This is the same patient whose *other* hip furnished Figure 14.

Fig. 13. Loose fracture. Woman of 46, vigorous. Reduction, artificial impaction. Three months in spica. Convalescent splint to 6 months. X-ray taken at 7½ months. Solid, function nearly perfect, but hip and knee are still somewhat stiff.

Fig. 14.

Fig. 15.

Fig 16.

Fig. 17.

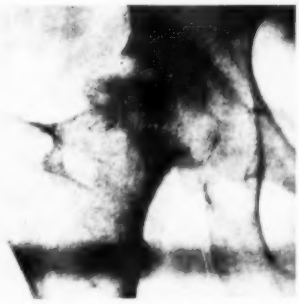


Fig. 18.

Fig. 14. Eleven years ago this patient, then 56 years old, had a loose fracture of the hip, which I reduced and impacted and treated according to my routine. After about 9 months she was back on full duty as a hospital superintendent and within a year had a perfectly normal hip without even limitation of motion. Ten years later she broke the other hip. (See Figure 12.)

Fig. 15. The *latest* case of artificial impaction so far. Not seen by me until, on the removal of a Whitman plaster at 3 months the whole thing fell apart. I saw him at 3½ months and considering his age (then 28) decided to take a chance. Reduced fracture at 14 weeks after the injury, and impacted. Then I followed my routine treatment. Plate here shown was taken 2 years and 4 months after the date of my impaction. Function is literally perfect.

Fig. 16. Same case as in Figure 15. Hip re-reduced and impacted at 14 weeks. Result shown 28 months later. He is standing on the injured leg. There is (shown in Figure 15) a bit of coxa vara deformity, but it cannot be demonstrated clinically. Of course some part of the result must be credited to his youth and vigor, but that did not seem to help while he was in the Whitman abduction spica.

Fig. 17. Another late reduction and here in an elderly patient of 73, untreated for 7 weeks, with a loose fracture. Usual reduction and impaction and care. Absolutely perfect function. X-ray after 2 years.

Fig. 18. The same patient just 2 years and a month later. No symptoms at all but a curious absorptive process in the solidly united, but not fully nourished head. Because the patient has had infantile paralysis from childhood which has affected the other leg, this hip has to work pretty hard for its living.

Figure 4 is useless and cannot hold under the inevitable absorption process. A position as in Figure 5 would not give a satisfactory result even if the fragments held and united.

In such cases, do not hesitate to "break up" an impaction, then reduce it, and re-impact with the big mallet. After this the technique of double spica etc., as described is followed.

Artificial impaction, useful as it has proved to be, can do no more than give an initial fixation which corresponds to the more favorable types of accidental impaction. It gives no assurance, *per se*, of bony union. It has no influence, on absorption of bone, or on repair.

After artificial impaction, one must fix the limb in the spica, must protect with splints,

Fig. 19. Fig. 20. Fig. 21.

Fig. 19. Woman of 49 years had a loose fracture which was reduced and impacted. X-ray shows result a year and a half later. Union is solid, function is fair but limited by previous arthritis, particularly of both knees.

Fig. 20. Woman of 53 years had a loose fracture which was impacted by Dr. Otto Hermann 3 years ago. She has perfect function and almost perfect motion.

Fig. 21. Man of 50 years had a loose fracture which was reduced and impacted later, followed by the usual routine treatment. The roentgenogram that is here shown was taken after 10 weeks. No recent roentgenogram has been made, nevertheless the patient went back to work and secured full usefulness of the limb very promptly after leaving the hospital.

just the same as if he were treating the rare case of a satisfactory accidental impaction.

But remember artificial impaction does put the otherwise nearly hopeless loose fracture, or the poorly impacted, badly placed fracture into the most favored class for later treatment.

Not all my cases have done well, of course. Probably there will never be any large series to report of really satisfactory results in hip fractures, for the reason that such injuries so often occur in the elderly and infirm.

So far, I think we can say that the not unusual result, a "sloshy" loose hip, may be avoided, at no extraordinary expense of time and comfort, that a firm, supporting joint may be achieved, usually with bony union, usually with fair motion, and often enough with nearly perfect motion.

That this technique calls for 3 months in bed and for at least 2 more months in a restricting apparatus, seems to me of no great moment as compared with the life invalidism as a result of treatment in the other way.

SUMMARY

The routine treatment, then, in intracapsular fractures is as follows:

If the fragments are in satisfactory position and impacted, the impaction is left alone. The limb should be placed in abduction (not extreme) and in sharp internal rotation. This is accomplished with a double spica with a cross bar. This spica should be kept on up to 3 months. A convalescent splint is then applied in routine cases by day and sandbags are used by night. Massage, gentle passive movements, are begun. The patient is allowed to be up on crutches. The apparatus is removed when the X-ray shows definite union or definite failure to unite.

In loose fractures, the fracture is reduced and the fragments impacted. The same treatment as described is then followed.

In cases with poor impaction or if the parts are in distorted position, the impaction is broken up, the fracture is reduced, and after re-impaction the same treatment as described is followed.

A consideration of conditions and results prompts the division of hip fracture patients into three classes: Youthful patients or physically competent middle-aged individuals; middle-aged people, sound but often "soggy"—unfavorable surgical risks as a rule; aged patients, sound or not, past the period when repair of a normal sort is to be expected.

The first class give the "show" results; the second class do well but convalescence is slow as a rule; in the third, union always results but

Fig. 22.

Fig. 23.

Fig. 24.

Fig. 22. Woman of 58 years. Fracture was reduced, impacted, and protective splint later. She wore this too long, due to getting lost in the Out Patient department. This X-ray was taken nearly 2 years after injury. Function is nearly perfect. She has some habit limp but no serious loss of motion from the bony overgrowth.

Fig. 23. Woman of 50 years. Patient had a loose fracture which was reduced, impacted and the usual treatment followed. X-ray shows result at 18 months. She has perfect function with a little limitation of hip and of knee motion.

Fig. 24. Woman of 52 years. She had a loose fracture which was reduced and impacted, and the regular treatment followed. A convalescent splint was employed for 4 months after the spica. The roentgenogram at 10 months shows solid union but she has some pain, also some disability largely due to an old fracture of the tibia into the knee of years ago.

very slowly with a good deal of absorption going on.

A good many patients would be surprised to find themselves in either of the last two classes, but the fact is that the women (and nearly all hip fractures are in women) who are now in their sixties and seventies are not good risks as fracture patients. They may have no definite lesions, but they have little muscle, less control, and very often, a rather inert habit of mind.

I am of those who believe that the present-day "flapper" is a very great improvement on her grandmother. A hard little animal, stoic, trained away from emotion, she is going to make the treatment of senescent lesions a very much simpler problem for our successors of, let us say, 1960.

We can almost assure the old lady with a fractured hip that she will get bony union or at worst, under our routine, a short fibrous union, mechanically serviceable. In at least three-fourths of the cases that come into our hands, bony union can be secured by the method described.

But, with such results as far as actual repair is concerned, the clinical results, measured in terms of use of the hip, are curiously dependent on the age and type of the patient and on the kind of reaction she shows to convalescent conditions.

In the series to follow, there is a case of fracture in a youthful person of far past 80. She is as good as you or I, today, in body, mind, courage, and interest. Therefore she is going about with a hip not only solid but thoroughly useful to her. Repair has been slow, of course, because of her age, but healing is now complete and bone union seems to be complete.

The gathering together of these cases has been very instructive, at least to me. More clearly than before I see that age must be reckoned with; after 70 or 75 repair is not so good.

More important, practically, is the matter of convalescent splinting. Many years ago Newton Shaffer got a clinical cure in an old case by splinting in abduction. Bradford has reported cases successfully treated in ambulatory fashion with his abduction splint, a splint that no adult ever would put up with for anyone but dear old Dr. Bradford, but an efficient splint. Campbell, of Memphis, was the first to emphasize convalescent splinting to remain in place for a long period.

Fig. 25.

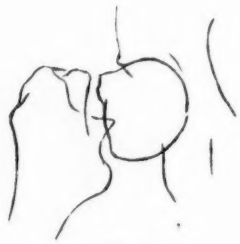
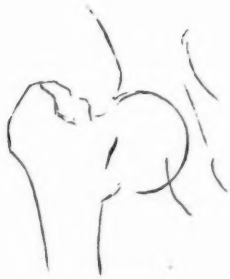


Fig. 26.



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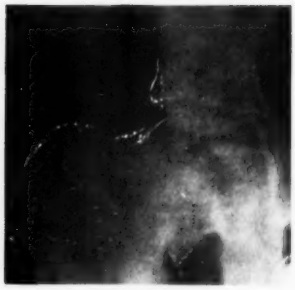

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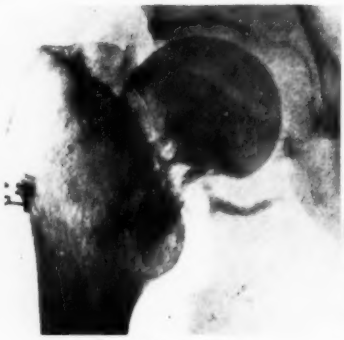


Fig. 29.

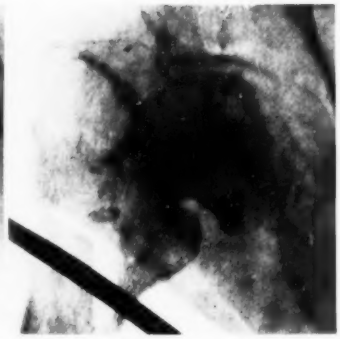


Fig. 30.

Fig. 25. Fire captain of 63 years, very vigorous, had a loose hip fracture, which was impacted after reduction. Usual routine treatment followed. Union was a bit slow. Protective splint was worn for 6 months after the plaster. X-ray at 11 months from date of injury shows solid union. Function is good but flexion is still somewhat limited and arthritic stiffness of both knees is present. Now at 65 years, he has retired from the department but is very active, doing many miles of walking.

Fig. 26. Loose hip.

Fig. 27. Same 8 months later, after artificial impaction and usual routine.

Fig. 28. Woman aged 55 years when injured. This was 14 years ago. X-ray was taken 13 years ago. This patient happens to be working for some of my family. Her activity is extraordinary, the hip function perfect.

Fig. 29. Man of 54, suffered a loose fracture which was impacted with a mallet. Delayed union. Convalescent splint was worn for 14 months but he was active in this period using only a cane. X-ray shows a bony union but apparently dotted with cartilaginous or fibrous areas. He has a slight limp when he hurries, but no pain. Flexion, two-thirds.

Fig. 30. Man in late sixties. Artificial impaction was applied followed by protective splinting. Here again is a patient who did not report back when told to; therefore he remained too long in the splint. X-ray at 10 months after injury showed solid union. Good function is present but limb is not supple.

Fig. 31. Woman in mid-sixties, had a loose fracture. Artificial impaction but with delayed union. A splint was applied. Further delay from pneumonia. Slow union. Now solid and the limb useful, but she is pretty stiff in movement.

Fig. 32. Woman, of 48 years. Again union was slow with a tendency to separation at the top. She was seen first in bed 2 weeks after removal of the spica. A Thomas convalescent splint was worn for a year. Union is now solid but she has limited motion of hip and knee.

Fig. 33. Another case that tried to come apart. The X-ray shows the end-result, perfect function. Same case as that of the tracings in Figure 10.

Fig. 34. Case of woman in mid-fifties, reduced for Dr. Cushing at the Peter Bent Brigham hospital. Loose fracture, here shown, as of January 5, 1916.

Fig. 35. Same case as in Figure 34 showing imperfect union at upper edge, after removal of plaster May 1, 1916. Convalescent splint was worn.

Fig. 36. Same case. Next year March 13, 1917. Excellent function. Solid union.

Fig. 37. Another case of deliberate union. These are the cases that, not checked up, account for the bad end-results in what seem promising cases. This patient was only 46, but was suffering from a bad myocardium, etc. The fracture was loose; it was reduced and impacted but I did not get her for a fortnight after the injury. Thus the unreduced fracture.

Fig. 38. Same patient as in Figure 37, 10 weeks later, in plaster. Note the slight overcorrection into coxa valga I like to do this, when I can. (See Fig. 13.)

Fig. 39. Same patient as in Figure 37 at 7 months (in convalescent splint). Position perfect. Union apparently fibrous only. She was allowed to walk about a bit with and without the splint.

Fig. 31.

Fig. 32.

Fig. 33.

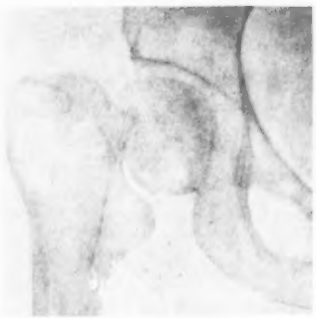


Fig. 34.

Fig. 35.

Fig. 36.

Fig. 37.

Fig. 38.

Fig. 39.

(Description on opposite page.)

Fig. 40.

Fig. 41.

Fig. 42.

Fig. 40. Same patient as in Figure 37 at 18 months. No question of the bony union now but note the extent of absorption of the neck after a *solid* fibrous union, occurring *later than 7 months* after injury.

Fig. 41. The kind of union one gets at 80, after absorption. A distorted break, lightly impacted in extreme outward rotation. Reduced and impacted. Four months' fixation and protection. Regained good function but with a limp.

Fig. 42. Woman of 60 odd. Good reduction and impaction was secured but there was excessive absorption with delay in union. Apparently she was much helped by diathermy. Final complete union shown in X-ray. Function good but motion limited; she has a limp.

Lately, I keep the splints on until the X-ray shows it is safe to let the patient go without them.

Cases like those shown in Figures 32, 33, and 44, under any ordinary routine treatment, would not have achieved union at all.

A routine such as I now use is onerous enough to make one wish for the patient's sake for a better method. So far, we have no better, no reasonably easy way of getting proved results. The only redeeming feature in this situation is that a convalescent Thomas splint,

Fig. 43.

Fig. 44.

Fig. 45.

Fig. 43. Woman of 79. For years she was a sufferer from hypertension. Fracture was reduced, impacted, a spica applied, later a convalescent frame splint, then the walking Thomas splint. This film was taken at 14 months. She walks without splint or cane and with very little limp but some stiffness. She can do everything but get out of her chair alone.

Fig. 44. Patient 86 years old; double pneumonia during convalescence. Usual routine except for this. This X-ray was taken at 13 months. She goes about with a cane; can travel stairs, not easily; and has a little trouble in sitting. Union is solid and I think bony. Note the grade of arteriosclerosis of femora and profunda as indicated by the crosses.

Fig. 45. Woman of 77. Usual treatment. Union is solid, but there has been extreme absorption and mechanically there is some limitation of flexion and of abduction. She is, however, very active: now in Italy for the season.

adequately fitted, is not so great a nuisance as one would think.

Very lately, the scheme of spiking hip fractures and allowing early motion has been revived. Possibly the development of a better technique in spiking may get good results, but those of us who used the method many years ago, and have watched their own results as well as those of others, are a bit skeptical. Follow-up reports are a bit scarce and a bit recent, and there are already failures.

Nevertheless, if any available technique will give real fixation, with a chance of early motion, and at the same time without hindering—then, of course, we want to use that method in all cases fit for operative handling. The latest question is whether fixation by artificial impaction (no spike) may perhaps allow earlier application of a convalescent splint and diathermy. I do not yet know. There is no question but that early function *per se* promotes union. The only question is whether early function is consistent with real fixation, or only with a wobble. Wobble between fragments (even a little wobble) is what ruins our results, it seems.

So far as we have gone, it seems that Campbell's cases—an admirable series—, a list not yet published from the Massachusetts General Hospital, and these cases here presented, are the only data resting on any great amount of grouped data that give any idea as to what we can do with fractured hips.

As to "artificial impaction," please understand that I claim only that this method puts the limb in shape for the proper and successful treatment for satisfactorily impacted fracture.

This much it has done,—and will do.

TRANSITIONAL CELL EPIDERMOID CARCINOMA

A Radiosensitive Type of Intra-oral Tumor

By DOUGLAS QUICK, M.B. (Tor), F.A.C.S., and MAX CUTLER, M.D., New York
From the Memorial Hospital and the Department of Pathology, Cornell University Medical School

In a recent study of cervical lymph nodes invaded by metastatic carcinoma from primary intra-oral lesions, certain observations were reported bearing on the relationship between structural characteristics of the tumor cells and their response to radiation. It was pointed out that from the group of epidermoid carcinomata there could be singled out a number of cases in which the tumor cells displayed an unusual susceptibility to radiation and presented peculiar histological features. These cells lacked the usual features of squamous carcinoma, presented transitional epithelial characters, and were designated by the term "transitional cell epidermoid carcinoma." Since this study, further observations have furnished additional data both clinical and pathological, which tend more clearly to define this condition.

In 1923, Crowe and Baylor (1) reported a series of nasopharyngeal carcinomata in which they described, in detail, the peculiar manifestations of carcinomata in this region and pointed out the difficulties in the histological differentiation of these tumors from the sarcomata, but they were not impressed with the association of the clinical syndrome which they describe with a specific histological structure of the tumor.

Marked variations in the clinical course of tonsillar, lingual, and laryngeal carcinomata have been commonly observed and recorded. Some of these tumors grow slowly, tend to remain localized for a long period, and metastasize late; others progress more rapidly, metastasize early, and are subject to ulceration and early suppuration. An unusually rapid course in lingual, tonsillar, and pharyngeal tumors has also frequently been observed. Extensive involvement of cervical nodes with comparatively small tumors of the œsophagus has been described. The structure of these tumors has usually been recorded as embryonal or anaplastic in type. There may be extensive involvement of one or both sides of the neck from a primary lesion which it is difficult to locate even at autopsy.

It is quite evident, therefore, that within the group of epidermoid carcinomata, particularly of the tonsil, base of tongue, and larynx there occur cases which show a high degree of malignancy and run an unusually rapid course. Furthermore, in those cases which have shown this clinical picture the lesion has been associated with a specific histological structure. Histologically, these tumors have been recorded as atypical epidermoid carcinomata, anaplastic, or embryonal tumors. Because of their diffuse character and the small size of the cell some have been designated as reticulum cell sarcomata and lymphosarcomata.

The exact origin of these tumors is difficult to determine, but several possibilities suggest themselves. In the nares (Schneiderian membrane), crypts of the tonsil, base of tongue, and in the folds and sinuses of the larynx transitional epithelial cells are found which may well be the source of the transitional cell tumors. The origin of some of these tumors with an alveolar arrangement of polygonal cells has been traced by Steiner and Kaufman to the ducts of mucous glands which are known to contain transitional epithelium. Another possibility is that these tumors arise from squamous cells which in their growth fail to develop spines, lose their adult epithelial characters, undergo anaplasia, become changed to an indifferent rounded or polyhedral form and grow diffusely as anaplastic tumors. A third possibility is that they arise from misplaced portions of embryonal tissue. Their structure however does not favor an embryonal origin.

Of the three possible sources, it is believed that the first two are the most likely, i.e.,

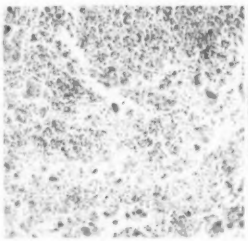
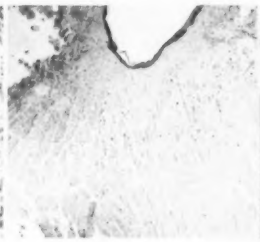


Fig. 1.



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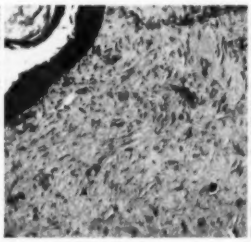

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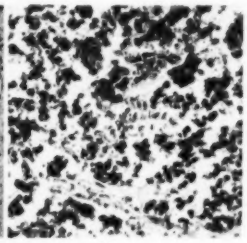

Fig. 4.

Fig. 1. Case 1. Photomicrograph of primary lesion in base of tongue. The tumor cells are indistinct and diffusely scattered in the lymphoid stroma.

Fig. 2. Case 1. Healed ulcer at base of tongue, previously the seat of transitional cell carcinoma completely destroyed by radiation. Patient died of visceral metastases. Specimen obtained at autopsy.

Fig. 3. Case 1. Photomicrograph of lesion at base of tongue showing cellular scar tissue fully covered by squamous epithelium with no signs of carcinoma. This site was previously the seat of transitional cell carcinoma as proved by biopsy.

Fig. 4. Case 1. Photomicrograph of metastatic nodule which was located in the liver and which was a metastasis from the transitional cell carcinoma primary in the base of tongue. The tumor is a very cellular round and polyhedral cell, highly anaplastic carcinoma in which squamous characters are entirely lacking.

either that they arise from transitional epithelial cells which are known to be present in locations where these tumors most commonly arise or that they spring from squamous cells which lose their epithelial characters and assume anaplastic features. Both clinical and pathological evidence indicate that their origin is probably from deep rather than superficial structures.

Histologically, the cells are small, uniform in size with a relatively large hyperchromatic nucleus and scanty cytoplasm. They are closely packed, with little intercellular substance. The cells sometimes form solid groups, sometimes they grow in anastamosing columns of opaque granular polyhedral cells with convolutions. Flat pavement characters, spines, hornification, and pearl formation are regularly absent. These structural characteristics are maintained in the metastatic cervical lymph nodes and distant visceral metastases.

Although it has been observed that occasionally metastases from squamous carcinoma may lose their adult epithelial characters and display anaplastic features this phenomenon is a rare exception. Generally, squamous carcinoma tends to maintain its structure rather rigidly, so that hornification, spines and pearl formation are often observed in the local and distant metastases as well as in the primary tumor. In metastatic nodules in the liver extensive hornification and spine formation are observed. Histological studies of a series of intra-oral carcinomata revealed that the cell structure of the primary lesion as shown by biopsy was maintained rigidly throughout, in the lymph nodes and visceral metastases.

Whereas the histological features and many of the clinical peculiarities of these tumors have been observed, their unusual susceptibility to radiation has not been pointed out. Deep carcinomata of the tongue have been observed to regress under roentgen therapy alone. Advanced tonsillar carcinomata with metastatic cervical nodes have been observed to show unusual regression after radiation. The explanation of these phenomena has not been clear. In view of what has been said it is evident that in these cases the tumor process has not been of the squamous type, but of the radiosensitive transitional form, and the striking regression in response to small doses of radiation may be explained on this basis. The fact that these paradoxical results have occurred in the same anatomical locations where the transitional cell has been found to be most common, namely, the tonsil, base of tongue, and nasopharynx, is further evidence that this explanation is probably correct.

In a group of radiated cervical lymph nodes recently described by the authors, many instances of marked response to radiation were observed following relatively small doses. An investigation of the type and structure of the

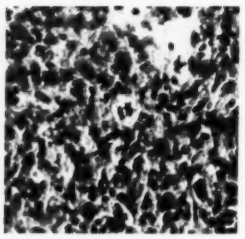

Fig. 5.

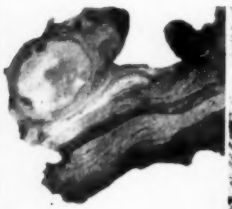

Fig. 6.

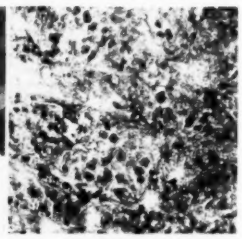

Fig. 7.

Fig. 5. Case 2. Biopsy specimen from transitional cell carcinoma of tonsil. Tumor in primary lesion and metastatic cervical nodes completely destroyed by external radiation. Patient died of visceral metastases. Note mitotic figures.

Fig. 6. Case 2. Photomicrograph showing complete destruction of transitional cell carcinoma in cervical lymph node following external radiation. The darkly stained nuclei are remaining lymphocytes.

Fig. 7. Case 2. Gross specimen of cervical lymph node after external radiation showing complete necrosis of tumor tissue (see Figs. 5 and 6). Primary lesion in tonsil.

cell as revealed by biopsy taken from the primary lesion soon revealed that in these cases we were dealing with a cell devoid of squamous characters and showing lack of differentiation. Differences in the mode of regression of the transitional cell and squamous carcinoma were pointed out. Rapid and massive liquefaction necrosis associated with a rich exudation of lymphocytes and plasma cells are characteristic effects of radiation upon the transitional cell tumor.

The infrequency of internal metastases from intra-oral carcinomata is well known. In Crile's series it was noted in only 1 per cent of the cases. Because of the undifferentiated quality and loose structure of transitional epithelium, it is reasonable to suppose that it would metastasize earlier and more widely than the squamous cell. Metastasis is undoubtedly favored by an atypical structure and by an origin from deep rather than superficial structures.

A close study of 2 cases of transitional cell carcinoma presented the opportunity to collect important data bearing on this point and served to confirm the above impressions. Complete autopsy of 1 case and an exploratory laparotomy of the other demonstrated bulky internal metastases in both. Two other cases are reported in detail to point out other characteristic features in the clinical course of the disease.

Case 1. H. A., male, aged 57, November, 1924, developed a swelling of the right side of the neck which progressed for a period of 2 to 3 months under the diagnosis of chronic lymphadenitis. The family and past histories were negative. In February, 1925, a dissection of the right neck was done and an infiltrating epidermoid carcinoma found on section. Thorough exploration of the pharynx, nares, larynx, œsophagus and tongue failed to disclose any primary lesion, and there were no localizing symptoms. A diagnosis of branchiogenetic carcinoma was made. About the same time a slight induration was suspected at the base of the tongue and a liberal piece of tissue was removed which failed to show any trace of carcinoma. In April, 1925, a second operation was done, all the nodes of the right side of the neck being completely dissected, but no trace of carcinoma was found in any of the tissues. About July, 1925, there was slight bleeding and pain at the base of the tongue, and a section was taken which for the first time disclosed the primary lesion, a transitional cell epidermoid carcinoma (Fig. 1). At the same time an enlarged node appeared on the left side of the neck about 2 centimeters in diameter. Examination of the lesion at the base of the tongue (July, 1925) revealed a circumscribed, ulcerated new-growth involving the base of the tongue on the right side. On July 23, 1926, 6 gold tubes (0.2 millimeter filtration) each 2.71 millicuries were implanted into the tongue lesion (total 2151 millicurie hours). Following the radiation there was very satisfactory regression of the primary lesion as well as the metastatic node and the general condition improved. In November, 1925, the lesion in the tongue was completely healed; there was, however, a soft swelling present above and below the right clavicle but no definite mass. There was no mediastinal shadow on X-ray and the lungs were negative. From this time on the patient's general condition became worse, he developed a marked anorexia and nausea, but no vomiting, also some abdominal pain referred to the upper right quadrant. Examination at this

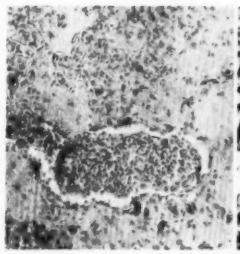

Fig. 8.

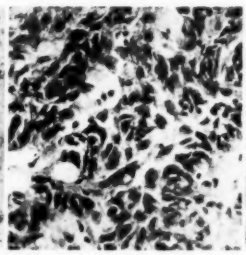

Fig. 9.

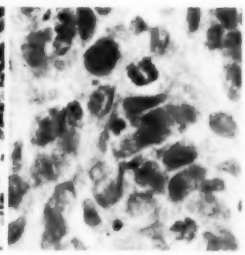

Fig. 10.

Fig. 8. Photomicrograph showing early invasion of lymphatics by transitional cell carcinoma in a nasal growth mistaken clinically for a nasal polyp. The patient was a young girl, aged 24. This process probably accounts for the early lymph node involvement in these cases.

Fig. 9. Case 4. Photomicrograph of transitional carcinoma of larynx. The lesion was considered so far advanced that only surface radiation was employed as a palliative measure. The lesion responded rapidly and cleared up entirely. The patient is entirely free of disease after almost 2 years.

Fig. 10. Case 4. High power of biopsy specimen. Note mitotic figures.

time revealed a moderate degree of tenderness over the region of the liver and an indistinct mass, probably an enlarged liver. The patient's condition grew worse, the mass continued to increase in size, he developed moderate ascites, and later jaundice of the skin and scleræ, also petechial hæmorrhages, and he died on May 11, 1926.

At autopsy, the hepatic flexure of the colon was firmly bound to the liver by dense adhesions. The liver was enormously enlarged, the right lobe was occupied by three large tumor masses, soft and hæmorrhagic. One appeared as a cyst lined by tumor tissue and filled with recent blood clot. At the base of the tongue there was a healed scar with no gross signs of carcinoma on section (Figs. 2 and 3). Microscopic examination of the lesion at the base of the tongue showed cellular scar tissue with no signs of carcinoma. The tumor in the liver was a very cellular, round and polyhedral cell, highly anaplastic carcinoma (Fig. 4).

Case 2. J. S., male, aged 45, developed an enlarged node in the left side of his neck 5 months before admission. Four months after the node was detected he experienced slight pain in his throat on swallowing. Examination revealed a movable node 2 by 3 centimeters in the upper right cervical chain and a deeply infiltrating neoplasm involving the right tonsil. A biopsy specimen taken from the tonsil showed a transitional cell epidermoid carcinoma (Fig. 5). The primary lesion was treated with gold radon implants and the cervical nodes with high voltage X-ray and the radium "pack." Both responded favorably to radiation, the primary lesion healed without sloughing and the cervical node decreased markedly in size. Two weeks later the cervical node was removed (Fig. 7). On histological examination there was complete destruction of the tumor with a few scattered foci in which shadows of epidermoid carcinoma could be made out (Fig. 6). The patient's general condition improved and for 1 year and 4 months there was no evidence of disease locally or generally. Sixteen months after the patient was first seen he presented himself in a weakened condition from intestinal obstruction. A laparotomy was performed and a tumor mass found in the lower dorsal and upper lumbar region obstructing the splenic flexure. The patient died 2 months later. No autopsy was obtained.

An analysis of the inception, clinical course mode of termination, and pathology of these 2 cases makes it obvious that we are dealing here with a condition which differs markedly from the routine squamous cell carcinoma of intra-oral origin. Furthermore, these cases present a striking similarity in their clinical course and pathological findings. In both cases the site of the primary lesion was the tonsil and base of the tongue. In both, the first manifestations of the disease were in the cervical nodes. In Case 2, 4 months elapsed, and in Case 1, 8 months elapsed between the first appearance of nodes and the discovery of the primary lesion, in spite of the fact that in Case 1, the patient was under competent medical observation from the time the nodes first appeared. The susceptibility of the lesion to radiation was so marked that in both cases the primary lesion and metastatic cervical nodes were rendered entirely free of the disease as proved by histological examination, differing in this

very important way from the resistant squamous cell carcinoma. The comparatively early and wide dissemination of the disease with bulky visceral metastasis and rapidly fatal course further differentiates these cases from the slowly growing squamous cell lesion. Associated with these characteristic clinical features is encountered a specific histological structure to which the term "transitional cell epidermoid carcinoma" has been applied.

CASE 3. N. G., male, aged 50. In February, 1923, patient experienced difficulty in breathing and about the same time noticed a small lump on each side of the neck. The growth on the right side remained stationary and that on the left increased in size. Examination on admission revealed a mass of enlarged nodes in each upper cervical region. There was a swelling on the posterolateral wall of the pharynx on each side just behind the tonsillar pillar. A diagnosis of lymphosarcoma of the neck was made. X-ray films of the chest revealed definite evidence of mediastinal involvement. Following radiation the mass on the left side of the neck was removed. In view of the apparent absence of a primary lesion a diagnosis of branchiogenetic carcinoma was made. About the same time a suspicious lesion was noted on the posterior pharyngeal wall and a biopsy specimen taken. The pathological report on this tissue was "squamous carcinoma." (At that time the distinction between squamous and transitional cell carcinoma had not yet been made.) One week later, the mass of nodes on the opposite side of the neck was removed and a similar pathological report obtained. In January, 1926, the patient was admitted to another hospital with local recurrences in the neck. The mass on the left side was removed and gold radon seeds were implanted on the right side. Several days later he suddenly became dyspnœic and cyanotic and died within a few hours. An autopsy was not obtained.

The clinical course of this case presents several interesting features. In the first place the picture was dominated by the metastatic process, while the primary lesion remained unrecognized, consequently a diagnosis of lymphosarcoma of the neck was made. After histological examination of the cervical nodes had revealed an epidermoid carcinoma, a clinical diagnosis of branchiogenetic carcinoma was made and the original diagnosis of lymphosarcoma abandoned. Three months later the patient developed a suspicious lesion on the posterior pharyngeal wall near the tonsillar pillar which for the first time revealed the seat of the primary lesion. This case is cited to point out the peculiar course of the disease and to emphasize the importance of excluding a primary intra-oral lesion before interpreting enlarged nodes as primary in origin.

CASE 4. F. C., male, aged 59, in April 1925, first noticed slight hoarseness associated with some soreness of the throat and a slight cough. On several occasions he coughed up bloody sputum. His general health remained good and there was no loss of weight. Examination revealed a granular ulcerated lesion on the right anterior surface of the epiglottis, near the base, extending onto the anterior part of the right vocal cord. In the right side of the neck, underlying the sternomastoid, was a firm movable node 2.5 centimeters in diameter. Examination of a biopsy specimen from the primary lesion revealed a transitional cell epidermoid carcinoma. The case was considered too far advanced to attempt curative treatment; consequently, it was decided to perform a tracheotomy and resort to surface radiation as a palliative measure. Table I shows the radiation employed.

TABLE I.—RADIATION EMPLOYED IN CASE 4

Radium[1]

Date	Millicurie hours	Area in Cm.	Filter	Distance Cm.	Applicator	Location
1-21-26	2500	4×5	2 mm. Brass	3	"Tray"	Right side of larynx.
1-27-26	2500	4×5	2 mm. Brass	3	"Tray"	Left side of larynx.
2- 8-26	10,000	8×12	2 mm. Brass	6	"Pack"	Right side of neck.
2- 9-26	10,000	8×12	2 mm. Brass	6	"Pack"	Left side of neck.

X-ray[2]

Date	Time in minutes	Voltage (peak) kilovolts	Filter	Target skin distance Cm.	Ma.
1-25-26	60	200	0.5 mm. Cu. 1.0 mm. Al.	50	4
1-27-26	60	200	0.5 mm. Cu. 1.0 mm. Al.	50	4

[1] For the radium "pack" 10,000 millicurie hours at 6 centimeter distance is approximately 90 per cent of an erythema dose. For the radium "tray" at 3 centimeter distance 2,500 millicurie hours is approximately 90 per cent of an erythema dose.

[2] Sixty minutes of "high voltage" X-ray with the factors given is approximately 85 per cent of an erythema dose.

Following radiation there was marked regression of the primary lesion and cervical node. Laryngoscopic examination showed marked radium effect and no evidence of disease, the primary lesion having entirely disappeared. The last examination made on July 20, 1927, revealed no evidence of dis-

ease in the larynx and complete regression of the cervical node.

This is a very remarkable case in that the primary lesion has apparently completely disappeared under moderate external radiation alone. At the present time, 2 years and 3 months after the beginning of symptoms there is no evidence of disease locally or generally, and the general condition of the patient is excellent. Although the time is still too short to predict the ultimate fate of this patient, the result up to date is very remarkable in view of the nature of the lesion and the advanced condition of the growth. The case furthermore points to the possibilities in the treatment of this type of lesion by external radiation alone.

ADDITIONAL CASES

CASE 5. J. H., male, age 50, was first seen in the out-patient department of the Memorial Hospital, May 6, 1924, with the history that 3 years ago he was struck by a hand ball in the side of the neck, and on the following day noticed a swelling in this region which had been gradually increasing in size. In May, 1923, this mass was removed, and was followed by a local recurrence in the scar. Examination at this time showed no evidence of a primary tumor and a diagnosis of branchiogenetic carcinoma was made. In November, 1924, the patient developed bleeding from the left nostril. Examination at this time disclosed a discoid mass 1½ centimeters in diameter in the left nasopharynx just above the orifice of the eustachian tube. A biopsy specimen taken from this lesion revealed a papillary epidermoid carcinoma, transitional cell type. The primary lesion was treated with bare tubes and the cervical nodes with high voltage X-rays and radium packs. A specimen of tumor tissue removed from the left maxillary antrum showed transitional cell carcinoma. The patient was last seen in June, 1926. At this time the tumor mass was filling the left temporal region pushing the eye forward. His general condition was fair.

CASE 6. W. J. B., male, age 61, was admitted in December, 1924, with the history that 6 months ago he noticed a swelling in the right side of the neck. He paid no attention to this until 4 weeks ago when he began to notice difficulty in swallowing. His general health has been excellent. Examination revealed two firm enlarged nodes in the right side of the neck, both freely movable. Direct examination of the larynx showed a bulky growth about 3 centimeters in diameter lying in the pyriform sinus. Five bare tubes, 5.1 millicuries each, were implanted in the primary growth (total 673 millicurie hours). Following heavy external radiation with high voltage X-rays and the radium pack a right neck dissection was performed. Examination of the tissue showed a transitional cell epidermoid carcinoma with marked radiation changes. At the present time the patient's general condition is excellent and there is no evidence of disease locally.

CASE 7. A. I., male, age 48, was admitted May 9, 1924, with the complaint that about 6 weeks ago he noticed a sore on the left side of the tongue. Examination showed an ulcerated area on the left border of the tongue extending toward the base. The cervical nodes were not involved. Bare tubes were implanted into the primary growth and external radiation was applied to the neck, after which a neck dissection was performed. Examination of the tissue revealed transitional cell epidermoid carcinoma with marked radiation changes. At the last examination on May 27, 1926, there was no evidence of disease.

CASE 8. N. L., male, age 58, was admitted June 10, 1924, with the history that 3 months ago he developed hoarseness which has been gradually growing worse. Swallowing has also been somewhat painful. Two weeks before admission a cervical node was removed for diagnosis and a report of squamous carcinoma returned. Examination revealed a bulky extrinsic lesion involving the right pyriform sinus of the larynx and extending upward to the base of the epiglottis. There was a questionable node in the left neck. Bare tubes were implanted into the primary lesion and radium packs applied to the neck after which a left neck dissection was performed. Examination of the tissue revealed a transitional cell epidermoid carcinoma with marked radiation changes. The patient was last seen in the clinic in July, 1924. At this time there was no evidence of disease. The patient has since been lost track of.

CASE 9. M. S., male, age 50, was admitted in July, 1924, with the history that 6 weeks ago he discovered a lump in the left side of the neck which has gradually increased in size. Three weeks ago he noted for the first time a sore on the side of his tongue. Examination revealed a very extensive lesion involving the left base of the tongue extending up onto the soft palate and involving the uvula and the tonsillar pillar. There was also a hard movable node in the left upper deep cervical chain. Treatment consisted in the implantation of bare tubes in the primary lesion and heavy external radiation to the neck followed by bilateral neck dissections. Examination of the tissue revealed a transitional cell carcinoma. The patient's general condition gradually became worse and he died in April, 1925.

CASE 10. M. A., female, age 48, in January, 1924, began to experience difficulty in breathing. Four months ago she developed pain in the left forehead and about the same time noticed a small lump in the left side of the neck. Examination revealed a growth in the ethmoid with marked swelling extending down to the tonsillar pillar. There was also a fixation of the larynx with œdema extending down to the pharynx. Treatment consisted in the implantation of platinum needles in the primary growth and heavy external radiation to the neck followed by a neck dissection. The pathological report was "transitional cell epidermoid carcinoma."

Her general condition became worse and she died in August, 1925.

CASE 11. J. A., male, age 38, first seen in October, 1925, with the complaint that 2 months ago he developed a sore throat and a mass in the right neck which gradually increased in size. Examination revealed a rather acutely inflamed granular mass about 4 by 5 centimeters apparently arising in the tonsil itself, invading both tonsillar pillars and running up behind the soft palate. It did not involve the base of the tongue. Just below the angle of the right jaw there was a soft smooth fairly movable mass about 5 centimeters in diameter. The clinical diagnosis lay between a lymphosarcoma and a transitional cell carcinoma. The pathological report from another hospital of a biopsy specimen taken from the tonsillar lesion was "reticulum cell sarcoma." Examination of the sections in our laboratory showed this to belong to the transitional cell group. Gold tubes were implanted into the lesion and external radiation applied to the neck mass. There was moderate regression following radiation but the general condition became worse and the patient died in February, 1926.

CASE 12. L. R., male, age 64, was admitted in February, 1922, with the complaint that about October, 1921, a lump about the size of an egg appeared in the left side of the neck, which had remained stationary. He noticed no difficulty inside the throat and there had been no other symptoms. Examination revealed a flat but deeply infiltrating and excavated new growth involving the left pyriform sinus and extending upward along the lateral pharyngeal wall to the epiglottis. A biopsy specimen taken from this lesion revealed a transitional cell epidermoid carcinoma. The primary lesion and mass in the neck were treated by the implantation of bare tubes and external radiation. The condition became steadily worse and the patient died in July, 1923.

CASE 13. F. B., male, age 39, was admitted October, 1925, with the history that in August, 1925, he developed a sore throat and some difficulty in swallowing. A physician was consulted who found a lesion on the left tonsil and took a biopsy specimen. The pathological report was that it was either an endothelioma or epithelioma. On examination two lesions were found in the mouth: one a papillary non-ulcerated firm growth springing from the gum about a lower right molar tooth; the other an extensive ulcer with necrotic edges and base involving the tonsillar pillars and posterior wall of the pharynx. No nodes were palpable in the neck, in spite of the extensive local lesions. A biopsy specimen showed apparently two processes: a squamous carcinoma in the meshes of which was an infiltrating large round polyhedral cell malignant tumor, probably an anaplastic epidermoid carcinoma (now classified as transitional cell carcinoma). Treatment consisted of implantation of gold tubes into the primary lesion and application of high voltage X-rays to the neck. The patient improved at first, but later declined and died December 19, 1925. At autopsy a very bulky extensive mass of retroperitoneal nodes was found. (The autopsy was performed in another hospital.)

CASE 14. O. R., male, age 45, was admitted October, 1925, with the history that 2 years ago a lump appeared in the neck, which grew rapidly until it reached the size of an egg. Five weeks before admission a burning pain developed in the throat. Examination revealed an ulcerated indurated lesion on the left posterior tonsillar pillar with numerous firm nodes in the neck on both sides. A clinical diagnosis of transitional cell carcinoma of the tonsillar pillar was made. A biopsy specimen was taken and a transitional cell epidermoid carcinoma found. Treatment consisted of implantation of gold tubes into the primary lesion and into the nodes and exposure of the cervical nodes to high voltage X-rays. There was marked regression of the primary lesion and nodes following radiation. The general condition improved and on the last examination there was no evidence of disease.

CASE 15. M. B., male, age 66, was admitted February, 1925, with the history that 2 or 3 months ago, a small lump appeared on the right side of the neck which was associated with some pain and difficulty in swallowing. Examination revealed a bulky indurated nodule with some ulceration, mainly anterior to the right tonsil and extending down to the level of the epiglottis. There was one firm node in the right carotid triangle. A clinical diagnosis of carcinoma of the right tonsil was made. Treatment consisted of the implantation of bare tubes into the primary lesion and the application of high-voltage X-rays to the neck followed by bilateral neck dissections. Examination of the radiated nodes revealed regressing transitional cell epidermoid carcinoma, with radiation changes characteristic of the transitional type of cell. There was satisfactory regression of the primary lesion and nodes following radiation, and the general condition improved.

CASE 16. W. P., male, age 59, was admitted February, 1924, with the history that 8 months ago while shaving, he noticed a small lump in the left side of the neck. Shortly afterward he began to experience pain and irritation in the throat at the base of the tongue. The nodes in the neck have gradually increased in size. Examination revealed a firm ulcerated mass involving the upper pole and anterior pillar of the tonsil with a mass of hard movable nodes in the left upper cervical region. A clinical diagnosis of carcinoma of the tonsil was made. A biopsy specimen revealed an epidermoid carcinoma, transitional cell type. Treatment consisted in the implantation of bare tubes into the primary lesion and the application of high voltage X-rays to the nodes in the neck, followed by a left neck dissection. At first there was a definite improvement in the general condition, but later the patient declined rapidly and died in August, 1924.

CASE 17. E. C., male, age 67, was admitted April, 1924, with the history that 3 months ago he first noticed a discomfort in the throat followed by moderate hæmorrhage. One week ago he discovered a lump in the neck which gradually increased in size. Examination revealed a deeply excavated ulcer which had destroyed the entire tonsil and involved the soft palate and lateral wall of the pharynx. A biopsy specimen revealed a transitional cell carcinoma. Treatment consisted in the implantation of bare tubes into the primary lesion and exposure of the neck to the high voltage X-rays followed by a left neck dissection. At first there was an improvement in the general condition of the patient, but later he declined rapidly and died in December, 1924.

CASE 18. A. D., male, age 26, was admitted March, 1923, with the history that in November, 1922, he developed a sore throat. In December, 1923, this was treated with the cautery with no improvement. For the past several weeks he has had 4 attacks of hæmorrhage from the throat. Examination revealed a very bulky growth involving the entire tonsillar region and base of tongue. There was a large firm node at the angle of the jaw on either side. A biopsy specimen revealed an epidermoid carcinoma, transitional cell type. Treatment consisted in the implantation of bare tubes into the primary lesion and the application of high voltage X-ray to the neck. At first there was satisfactory regression of the lesion, later, however, there was local recurrence of the disease, the general health of the patient grew worse, and he died in January, 1925.

CASE 19. W. T. O., male, age 73, was admitted September, 1924, with the history that in March, 1924. he felt a small sore on the inside of the left upper jaw which gradually increased in size and finally ulcerated. He consulted a physician who gave him X-ray treatments over a period of 4 months. Examination revealed an extensive ulcerated lesion on the upper left alveolar ridge involving the mucosa of the cheek anteriorly and laterally. There was a hard movable node 2 centimeters in diameter in the left submaxillary region. A biopsy specimen revealed a 'transitional cell epidermoid carcinoma." Treatment consisted in the implantation of bare tubes into the primary lesion and application of high voltage X-ray to both sides of the neck followed by a left neck dissection. There was satisfactory regression of the primary tumor and nodes following radiation. At the last examination the patient's general condition was fair, but there was some evidence of local recurrence of the disease.

CASE 20. D. D., male, age 49, admitted November, 1922, with the history that 1 year before he noticed a small lump on the left side of his neck which has been gradually increasing in size. He felt nothing inside his throat until about 3 months ago, when he began to have difficulty in swallowing. Examination revealed a deeply infiltrating neoplasm involving the anterior pillar of the left tonsil and an enlarged node in the left anterior cervical region. The local lesion was treated with bare tubes, and the nodes in the neck exposed to the radium pack, after which a neck dissection was performed. Examination of the nodes revealed a very cellular epidermoid carcinoma, transitional cell type, with focal destruction of tumor cells. There was marked regression of the tumor under radiation. The patient's general condition improved at first but later became worse. He died January 14, 1924.

CLINICAL ANALYSIS

Based upon histological examination of sections obtained from biopsy specimens and metastatic lymph nodes, 20 cases of transitional cell epidermoid carcinoma were selected and a study of the clinical history and course of the disease made with the view of determining any specific or characteristic features which might be associated with this particular type of cell growth. A special attempt was made to determine the presence of any features sufficiently constant and characteristic to permit clinical recognition of the nature of the lesion. The results of this study demonstrated four outstanding features which may be regarded as more or less characteristic.

1. *Location of the lesion.* Of 20 cases analyzed, the distribution of the primary lesion was as follows:

	Cases
Tonsil	10
Base of tongue	3
Larynx	4
Nasopharynx	2
Mucosa of cheek	1
Total	20

In several cases listed in the tonsil group it was impossible to determine whether the tonsil or base of tongue was the seat of the primary focus as the lesion when first seen had involved both regions. In a number of cases belonging to this group, the primary seat of the lesion was in the nares. In one case the condition was regarded as a benign polyp and the tumor excised locally. Because of the fact that complete data is lacking in these cases they are not included in this report. It is important, however, to recognize the nasopharynx as one of the favorite

sites of occurrence of this type of growth. It may be stated that the lesion is most common in the tonsil, base of tongue, and nasopharynx. The 14 cases of transitional cell lesions of the tonsil and base of tongue were selected from a group of 148 tonsillar and lingual carcinomata. These figures indicate the relative proportion of the squamous cell and transitional cell in these particular locations. Although these data are based upon a relatively small group of cases, yet we believe it is sufficient to point to the tonsil, base of tongue, and nasopharynx as the favorite sites for this lesion. The evidence presented by this group of cases is substantiated by the clinical experience that not infrequently carcinomata of the tonsil, base of tongue, and nares have been observed to show a phenomenal response to radiation. The explanation for the frequency of the transitional cell in these particular locations is not clear.

2. *Gross appearance of the lesion.* The appearance of the primary lesion is more or less characteristic and since attention has been directed to these growths certain features have been observed which give them an appearance differing from that of a primary squamous cell lesion. Squamous carcinoma usually presents a coarsely granular appearance which progresses to frank ulceration. The lesion, typically, has an elevated, indurated border with a depressed ulcerated crater. Contrasted to this the transitional cell lesion presents a finely granular, velvety surface which looks like an erosion of the mucous membrane rather than a frank ulceration. The lesion is flatter and gives the impression of having originated in the deeper structures and adhered to and eroded the mucous membrane from beneath. In a number of instances the gross appearance of the lesion has given an accurate clue to the diagnosis of transitional cell carcinoma.

3. *Clinical course.* Case 1 presents an unusual opportunity to study the clinical course of a typical transitional cell lesion. The first sign of disease was the appearance of a swelling of the right neck which for 2 or 3 months progressed under the diagnosis of chronic lymphadenitis. Removal of the mass revealed an epidermoid carcinoma and since very thorough exploration of the pharynx, larynx, nares, and œsophagus failed to disclose a primary lesion, a diagnosis of branchiogenetic carcinoma was made. Not until 8 months after the appearance of the cervical swelling was the primary lesion found. Pain and slight bleeding pointed to the base of the tongue as the seat of the primary lesion and a biopsy specimen supplied the diagnosis. The logical explanation for the course of events in this case would be that we are dealing with a deep-seated very cellular lesion having its origin at the base of the tongue. The cell being of a type which metastasizes early and grows rapidly, the disease becomes evident as a metastatic focus before the deep primary lesion approaches the surface and ulcerates. In the meantime, the clinical picture is dominated by the metastatic phenomena and the case proceeds under the wrong diagnosis of chronic lymphadenitis, branchiogenetic carcinoma, or endothelioma until the primary lesion ulcerates and produces symptoms.

Analysis of the clinical histories and course of the group of 20 cases revealed the interesting fact that in 13 of the cases the patients gave a history of having noted the presence of enlarged nodes in the neck as the first sign of disease before any abnormality referable to the intra-oral region was detected, and in 2 cases the cervical swelling and primary lesion became evident simultaneously. In 5 of the 20 cases thorough search failed to reveal a primary lesion and the cases progressed under the diagnosis of branchiogenetic carcinoma, endothelioma, lymphosarcoma and reticulum cell sarcoma until at a later date the primary intra-oral lesion became evident and the correct diagnosis could be made.

The course of events in these cases is similar to that found by other investigators in tumors which fall in this group. In a very careful and detailed study of carcinomata of the nasopharynx, Crowe and Baylor state that the first sign of carcinoma in this region is often a painless and rapid increase in size of the deep cervical glands at the angles of the jaw. Of 79 cases of carcinoma of the nasopharynx reported by New, 51 had enlarged cervical nodes. Eighteen of the 51

patients in whom the cervical nodes were involved had had operations on the neck without discovery of the primary tumor. A microscopic diagnosis of endothelioma from the node removed had been made elsewhere in 3 cases.

4. *Response to radiation.* The marked radiosensitivity of the transitional cell carcinoma constitutes one of its most important properties and differentiates it from the radioresistant squamous cell carcinoma. The difference in the radiosensitivity of these two types of cell is so marked that the response to radiation may give a clue to the nature of the condition. The response of the primary lesion and the metastatic nodes has been so marked that in many instances microscopic examination revealed complete destruction of all tumor tissue. From a therapeutic standpoint these differences assume considerable importance. The amount and type of radiation necessary to destroy the tumor process is obviously different for the two types of cell and the principles underlying radiation treatment of the squamous cell and transitional cell are undoubtedly not the same. Destruction of the squamous cell must occur through an intense effect from interstitial radiation or by very heavy external radiation whereas complete destruction of the transitional cell tumor may be accomplished in many instances with relatively small doses of external radiation.

DIAGNOSIS

The diagnosis of this condition should be based upon the clinical-pathological picture rather than on the histology or clinical features alone. Whereas, in certain cases the histological features are so typical that a diagnosis may be made on section alone, many instances occur in which the resemblance to other conditions is so marked that the microscopic picture should be considered only in conjunction with the clinical data in order to reach a proper interpretation of the case. In some cases the clinical features have been so characteristic that the proper diagnosis has been reached clinically and confirmed by section. The favorite site of the lesion (tonsil, base of tongue, and nares), its early metastasis, wide dissemination and rapid response to radiation are the predominant clinical features. The absence of squamous characters—hornification, spines, and pearl formation—differentiates the two conditions histologically.

Branchiogenetic carcinoma is differentiated by its histological structure, slow rate of growth, lack of response to radiation, and absence of a primary lesion. It is probably always squamous.

Primary endothelioma of lymph nodes may resemble transitional cell carcinoma in which the nodes are enlarged and primary lesion undetected. This condition was described by Chambard in 1880 under the term "primary carcinoma." Since then detailed reports of the gross anatomy, microscopic structure and clinical course have been furnished by Ewing and the disease is now generally regarded as a distinct entity. This disease is comparatively rare, commonly arises on the basis of a chronic granulomatous inflammation, especially tuberculosis, and is often classed as secondary carcinoma. The disease may occur as a systemic involvement of many lymph nodes or as single or multiple tumors of cervical, axillary, or other lymphatic chains. The localized tumors are commonly regarded as tuberculosis. The history of an antecedent tuberculous infection, the slower progress of the disease, the lack of response to radiation, and the persistent failure to find a primary intra-oral lesion are differential points in favor of endothelioma. A more rapid clinical course and a favorable response to radiation are in favor of secondary carcinoma. The detection of a primary intra-oral lesion establishes the diagnosis.

TREATMENT

Because of the marked radiosensitivity of the tumor on the one hand and its high grade of malignancy on the other, there is no question but that this lesion should be treated by radiotherapy. The very poor surgical results of highly malignant anaplastic tumors is only too well known. The inaccessibility of the primary lesion makes it difficult of surgical approach and complete removal. The primary lesion has been treated by buried gold

radon implants distributed as uniformly as possible throughout the growth. The results of the treatment of the primary lesion have been satisfactory in most cases. In many instances there has been complete regression of the disease, frequently without gross necrosis of tissues. The treatment of the metastatic cervical nodes has consisted of radiation with high voltage X-rays and radium, followed in most cases by neck dissections. Examination of the radiated specimens has shown in many instances complete destruction and devitalization of all tumor cells.

The ability to care completely for the primary lesion and metastatic cervical nodes by radiation has been demonstrated. The danger lies in the early dissemination of the disease to the viscera, so that whereas the primary lesion and cervical nodes have been cared for the patient returns with bulky visceral metastases. There are three possible explanations for this course of events: (1) The disease in the primary lesion or cervical nodes has not been completely destroyed; (2) the disease was disseminated by operative trauma; or (3) distant metastases were present though not demonstrable when the patient presented himself for treatment.

Our data indicate that the disease can be completely eradicated from the primary focus and cervical nodes. The lack of differentiation of the cell, its high grade of malignancy and clinical evidence of early lymph node involvement favor the view that when the cervical nodes are already involved distant metastatic foci are also present which do not become evident clinically until later. The danger of dissemination of a very cellular tumor by operative trauma is undoubtedly great and merits serious consideration.

RESULTS

Results obtained in the treatment of the cases included in this study are given in Table II below. Thirteen of the 20 patients treated are dead. Of the 7 patients alive, the interval is too short to designate any as cured. The unfavorable results obtained in the treatment of this group of cases as compared with the squamous cell carcinoma points to this lesion as the more malignant process.

TABLE II.—RESULTS IN 20 CASES

Case	Living	Dead
1		18 months
2		18 months
3		3 years
4	2 years 3 months	
5	3 years (local recurrence)	
6	2 years	
7	2 years	
8		4 months
9		12 months
10		2 months
11		6 months
12		18 months
13		4 months
14	2 years, 6 months	
15	2 years	
16		16 months
17		12 months
18		2 years
19	2 years, 6 months	
20		2 years

CONCLUSIONS

1. Within the group of intra-oral epidermoid carcinomata are found peculiar tumors presenting a specific histological structure to which the name "transitional cell epidermoid carcinoma" has been applied.

2. Transitional cell carcinoma is a highly cellular malignant tumor. The cells are small, uniform in size with large hyperchromatic nuclei and scanty cytoplasm, growing diffusely, sometimes forming solid cords. Adult squamous characters such as hornification, spines, and pearl formation are absent.

3. The exact origin of these tumors is as yet undetermined. It is believed, however, that they arise either from transitional epithelium, or that they arise from squamous epithelium which, in its growth, loses its adult epithelial characters and assumes anaplastic features.

4. The most frequent seats of occurrence are the tonsil, base of tongue, and nasopharynx.

5. Tumors composed of this type of cell form a small but definite proportion of intra-oral carcinomata. In the tonsil and the base of the tongue the proportion of transitional cell to squamous cell carcinoma is approximately 1 to 10.

6. The clinical course of these tumors is characterized by the early and wide dissemination of the disease, so that the clinical picture is dominated by the metastatic process while the small deep-seated primary

lesion, in many instances, remains undetected.

7. A review of the cases shows many instances in which this disease has been erroneously regarded as branchiogenetic carcinoma, endothelioma, and lymphosarcoma. This is due to the fact that the deep location of the primary lesion and its early metastasis cause enlargement of the cervical nodes before the primary tumor ulcerates and produces symptoms. Attention is called to the importance of thoroughly excluding a deep-seated primary transitional cell carcinoma before resorting to a diagnosis of primary disease of the lymph nodes.

8. The marked radiosensitivity of transitional cell carcinoma is one of its most characteristic properties. This property is so marked that the rapid response to radiation is a useful point in the differential diagnosis from the radio-resistant squamous carcinoma.

9. The ability to completely eradicate the disease in the primary lesion and cervical nodes by radiation renders this the method of choice in the treatment of this lesion. An attempt to prevent distant metastases should be made by treating the lesion as early as possible by a method devoid of trauma in order to avoid disseminating this very cellular tumor process.

The writers wish to acknowledge their indebtedness to Dr. James Ewing for his aid and suggestions throughout this study.

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CANCER OF THE PERIAMPULLARY REGION OF THE DUODENUM

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MANY writers on the subject of carcinoma of the ampulla of Vater have pointed out that the growth is ideally situated to make its presence known at an early stage. They have claimed that regional and distant metastases are late. Nevertheless the results of radical surgery have not been encouraging. In the reported cases, many patients presented a relatively long history of more or less indefinite complaints referable to the gastro-intestinal tract before the onset of the icterus that finally led to operation. It must be somewhat a matter of good fortune for both surgeon and patient to find the growth well localized to the intraduodenal portion of the terminal bile duct. It is most often, although not exclusively, in such situations that radical surgery has succeeded, or at least allowed the patient to survive the operation and the immediate postoperative period. Within the past decade eight cases of periampullary carcinoma of the duodenum have been operated on at the Mount Sinai Hospital, in three of which radical operation was performed. It is the purpose of this paper to report these eight cases and, at the same time, to review the literature of previously reported cases.

According to Gray (14), the caruncula major of Santorini, or the bile papilla, is a projection in the lower part of a longitudinal fold of mucous membrane regularly situated in the second, or vertical portion of the duodenum, usually on the posterior wall at its junction with its left border. At the summit of the papilla, which may be covered by a small transverse fold of mucous membrane, the bile and pancreatic ducts empty. In about 50 per cent of the cases, one inch above and one-half inch or more in front of the bile papilla is a much smaller papilla, the caruncula minor of Santorini, on the summit of which the accessory pancreatic duct of Santorini opens when present. The ampulla of Vater is a conical cavity formed by the fusion of the bile and pancreatic ducts and is much larger than the opening of the bile papilla. The average length of the orifice is 3.9 millimeters and the diameter 2.5 millimeters (Opie). The two ducts open by a common orifice, if there is an ampulla, or by two separate orifices, if there is none. In form the ampulla strongly resembles a clitoris, the apex being represented by a transverse fold or fissure, and the frenulum by the longitudinal fold of the duodenum. The papilla and ampulla, like other anatomical structures, are subject to variations. Letulle and Nathan (20), following a series of careful dissections, have described four types.

1. In the first type the projection just described and the ampulla are not present. The transverse fissure exists and in more or less complete fashion covers the choledochus opening. The choledochus receives the duct of Wirsung and pours the bile and pancreatic juices directly into the intestine.

2. The second type, which corresponds to the usual classical description given in most anatomies is more frequent than the one just described, but is not the most common. In the region of the papilla, there is an elevation ending in the ampulla. The common bile and pancreatic ducts, seemingly attached, open into this more or less rounded cavity, the depth rarely surpassing 4 to 6 millimeters, the diameter measuring 6 to 7 millimeters. Each of the canals seems to contract a few millimeters before it reaches the depth of the ampulla.

3. The third form is the form most frequently seen, being present in 8 of 21 cases. There is a small projection with a sort of depression, but no real ampulla. The choledochus and duct of Wirsung do not come together to form a common ampulla, but empty individually into the intestine, being separated by a membranous partition about 1.5 millimeters in thickness.

4. In the fourth type there is a large papillary projection with the same disposition

of the two canals previously noted. These open by a punctiform or circular orifice about 1.5 millimeter in diameter, the orifices being divided by a vertical fringe. In other cases, the duct of Wirsung forms a concave gutter around the choledochus, the two canals appearing concentrically arranged.

These variations have more than an academic interest, for in cases of obstruction of the duct of Wirsung, the pancreatic juice may still be supplied and delivered into the intestine by the accessory duct of Santorini, or, occasionally the duct of Wirsung, instead of terminating in the caruncula major, empties into the caruncula minor, so that an occlusion of the biliary papilla does not disturb the function of the pancreas in the least.

The histology of the ampulla of Vater is of importance because three different types of epithelium enter into its formation; that of the intestine, the choledochus, and the pancreatic duct. At the angle of the ampulla, intestinal epithelium is present with its large, clear, flat cells and mucous ones. The mucosa of the choledochus is formed by cylindrical cells, rather high, measuring from 25 to 30 microns. This mucous membrane is wrinkled, and between the plicæ, are open secretory canals of ramifying glands resembling the biliary type, but secreting more than those in the superior part of the choledochus. The epithelial cells of the canal of Wirsung present a much lower type, almost cuboidal, from 12 to 15 microns in height. So in papillary carcinoma, tumor cells may arise from the duodenal mucous membrane in the region of the papilla, from the glands of Lieberkuehn, from the glands of Brunner in the submucosa, from the mucosa of the choledochus, from the cells lining the pancreatic canal and, as Pic (22) and Pilliet (22) have shown, from the glands of aberrant pancreatic tissue which have been found buried in the depths of the ampulla. Much has been written upon the differentiation of ampullary, ductal, and duodenal malignancies from their histological appearance. Considered practically, the point of origin is only of academic interest because the clinical course and the surgical indications are the same in all groups.

While carcinoma of the choledochus is not common, it is four times as frequent as that arising from the pancreatic duct, making the latter and ampullary neoplasms rather rare.

If seen early, these tumors grossly present two varieties. They may be pedunculated growths, mobile in the ampulla, often covered with excrescences, occasionally eroded, varying in size from a small pea to a walnut or even larger, Angeli reporting a case in which the mass was the size of an orange. When they protrude from the ampulla of Vater, their origin is invariably from the common duct. The second group consists of the bloody, ulcerating, plaque type of tumors, which commonly arise from duodenal mucous membrane, occasionally so small as to be passed unseen in a hurried examination. The origin of the tumor is often very difficult to determine, even at autopsy, for a growth starting at the angle of the ampulla rapidly invades the duodenal wall, and since there is no sharp division between the mucous membrane of the duodenum and the choledochus, it is difficult to decide their intracholedochal or extracholedochal starting point. The differential diagnosis between choledochal tumors growing in the pars pancreatica, and primary pancreatic tumors, can usually be made because the former rarely invade the substance of the pancreas. Ampullary carcinomata regularly remain local and are late to metastasize, Perry and Shaw (27) noting metastasis in only 3 of 15 cases. In the four cases of periampullary carcinoma which were subjected to postmortem examination, from the surgical services of the Mount Sinai Hospital, New York, autopsy failed to reveal the presence of metastasis. Brewer (22) and Modowsky (20) believe that deaths occur before these tumors have a chance to metastasize, from the poisoning effects of the bile stasis and subsequent cholemic intestinal hæmorrhages; for while these malignancies are small and circumscribed, they cause compression and actual blockade of two canals, draining two important glands, the liver and the pancreas. Following obstruction at the papilla, the bile passages and the gall bladder become markedly dilated and filled with aseptic, thick bile,

high in its percentage of mucus. Mucus occasionally replaces the biliary elements entirely to form "white bile" as reported in the cases of Koerber (22), Riedel (24), Arnsperger (4), Kausch (15), and Lenormant (22) and Cohen. Stones are usually absent. The liver is enlarged, smooth, and green, projecting usually below the free border of the ribs. The pancreas is normal in size unless its canals are completely obliterated, in which case it is enlarged at first, only to atrophy subsequently from a fibrous pancreatitis. Should infection complicate the disease, acute pancreatic necrosis may rapidly ensue. In 51 cases of periampullary carcinoma gathered by Geiser (12), 46 had obstruction of the common duct, while only 12 were complicated by a simultaneous dilatation of the duct of Wirsung. In 4 of these the integrity of the pancreatic ducts had been disturbed. Letulle (19) reports an unique case in which the pancreatic duct alone was obstructed without interference with the choledochus.

If chronic irritation is a factor in the production of carcinoma, the biliary papilla or ampulla of Vater should be a site of predilection. The etiological factors involved are many. As the papilla projects into the lumen of the bowel it is subject not only to the irritation of the eddying alkaline currents from the ducts, but also to the acid wash of the gastric contents. While stones appear to be directly related to malignancies of the gall bladder, the causal relationship of cholelithiasis to these choledochal neoplasms is not as definite. Schueller (33), in 1901 reported calculi present in 6 of 41 cases, Outerbridge (25) in 1913, in an analysis of 110 cases from the literature was able to find mention of stones in but 23, about 20 per cent. In Pallin's (26) series of 52 cases reported in 1920, cholelithiasis was present in 13, 1 in every 4. Cholelithiasis as a rule occurs once in ten autopsies. While the proportion of cases of carcinoma of the papilla complicated by calculi may appear high at first glance, it must be borne in mind that the majority of patients with papillary tumors are rather advanced in years, and that the incidence of stones increases directly with age. Another very interesting and poignant fact is that while gall stones occur in seven females to one male, carcinoma of the papilla occurred in twelve males to one female in Pallin's series. Onati (26) and Payr (22) go so far as to state that carcinoma may be a predisposing factor in the formation of gall stones by obstructing free biliary drainage. It is, therefore, exceedingly difficult to draw any definite conclusions as to the relation of cholelithiasis to these malignant tumors. Nor can these growths bear any relationship to ulcers of the duodenum, for while the latter usually occur in the first portion, cancer is found in the second.

The symptoms which these neoplasms evoke are those of common duct obstruction with its associated sequelæ. Jaundice is the dominant and outstanding feature. Its appearance is insidious, unheralded by pain and its intensity increases progressively. In Pallin's series it was present in all the 52 cases, varying in duration from 2 to 4 months before operative relief was sought although cases have been reported in which the icterus was present for longer periods; in Morian's (38) case for one and three quarter years and in Mayo Robson's (25) case for 3 years. Koerte (38) believes that this form of icterus is constant in contradistinction to that caused by stone, in which the jaundice is variable and with remissions. This is not universally true because a complete obstruction may be converted into an incomplete one by ulceration of the neoplasm as is evidenced by the cases of Durand (22), Devic (26), Lender (18), Koerber (22), Hartman (34), Morian and Hotz (38), and in one patient, ulceration caused such a severe hæmorrhage that death resulted. This type of intestinal bleeding, however, must be differentiated from the cholemic hæmorrhages which are more common and just as serious, having been responsible for almost 50 per cent of the postoperative deaths. In the cases of Lannois (22) and Courmont (22), Van Decos and Baville (22), Schieve and Letulle (22), the duct remained patent while the tumor tissue strangely infiltrated the choledochus wall.

Severe pain is not an outstanding feature although epigastric distress was present in over half of Outerbridge's (25) series. In the

rarer cases in which the pain was colicky, stones were often present.

If the pancreatic duct is involved, or if a chronic fibrosis of the pancreas complicates the picture, it may be evident clinically by occasional glycosuria or absence of the pancreatic ferments in the aspirated intestinal contents. The use of the duodenal tube in the diagnosis of surgical conditions in the ampullary region of the duodenum, while not of exceptional value, should be continually employed. The significance of the findings have already been emphasized by Crohn (10) and more recently Chiray, Benda and Miloclavitch (8) have reported a case in which a clinical history together with repeated aspirations of fresh blood from the duodenum, with absence of bile lead them to suspect a malignancy of the vaterian ampulla which autopsy verified.

Physical examination aside from the emaciation and cachexia and the intense icterus shows a diagnostic sign of major importance in the enlarged gall bladder. This observation was originally made and popularized by Courvoisier. Cotte (38), quoting Carnot states: cancer in hepaticus, "petite vesicule"; cancer at the confluence; "grosse vesicule hydropique"; carcinoma in the choledochus. "grosse vesicule plein de bil." The enlarged gall bladder, though present, may not be palpated because the overlying liver which too is often increased in size, obscures it. In 28 cases of carcinoma below the confluence, all except 3 gave evidence of an enlarged gall bladder, and in 2 of these, stones were present in a typical hydropic gall bladder. In cases of choledochal carcinoma, Courvoisier's law is regularly upheld unless the gall bladder has been previously shrunken by the contracture of scar tissue secondary to the inflammatory reactions caused by infection and cholelithiasis. Modowsky (26) is not in accord with this, for he found the size and the contents of the gall bladder quite variable in cases of choledochal carcinoma. It is likely, however, that a number of his cases were carcinoma of the confluence, with the cystic duct opening low in the choledochus.

The clinical diagnosis of carcinoma of the biliary papilla is rarely made because the presence of an intense icterus automatically suggests either carcinoma of the head of the pancreas or impacted gall stone. Constant icterus, afebrile course, absence of pain, and a large gall bladder point to neoplasm; remitting jaundice, fever, pain, and a nonpalpable gall bladder favor impacted calculus. Icterus as a rule is constant, but in every fifth case it may vary. The constancy of a bilirubinæmia may be checked by repeated estimations of bile in the blood serum by any of the methods in vogue, and while not absolutely reliable is more exact than clinical impressions as to variations in color. Temperature in two-thirds of the cases is afebrile unless infection is present, when a typical intermittent fever may be present, not unlike the Charcot syndrome seen with stone. In a high grade constant icterus with an afebrile course, if the gall bladder is enlarged and there is reason to suspect malignancy, a diagnosis of carcinoma not only of the head of the pancreas, but also the papilla, or the choledochus should be entertained. It is really the possibility that the new-growth causing the obstruction might be periampullary which should induce surgeons to explore this type of abdominal malignancy provided the cholemic symptoms are not too far advanced. If the symptoms speak for a neoplasm, and the gall bladder is not enlarged, carcinoma above the confluence of the cystic and common bile ducts must be considered. It must be differentiated from chronic pancreatitis and hypertrophic cirrhosis, the latter condition strangely simulating these malignancies.

In other words, operation is indicated in all cases of obstructive jaundice, except those which are frank cases of carcinoma with metastasis, and an exploration should be performed early and not after months of purposeless medical treatment have so exhausted the patient as to render him beyond the pale of surgical intervention and redemption. For these individuals die, not from the surgical exploration or procedure, but from the toxic effects of a prolonged jaundice. Petren (26) is of the opinion that the severe danger of jaundice occurs when it has lasted from 3½ to 4 weeks, and that exploration should be done before 3 weeks have elapsed.

TABLE I—FIFTY-NINE CASES OF RADICAL OPERATION FOR CARCINOMA OF THE PERIAMPULLARY REGION OF THE DUODENUM

From 1898 to 1925

Year	Surgeon	Operation performed	Result
1898	Halsted (38)*	Resection of duodenum (circular suture) (end-to-end) reimplantation of choledochus and pancreatic ducts and cholecystostomy.	Death 7 months after resection from recurrence.
1899	Riedel (25)†	Transduodenal excision	Died from operative shock same day.
1900	W. Mayo (38)*	Cholecystostomy. 3 months later transduodenal excision with the cautery. 18 months later cholecystoduodenostomy because of recurrence	Died after operation for recurrence, from shock.
1901	Czerny (38)* (Schueller)	Transduodenal excision and cholecystostomy	Died after 5 days from retroduodenal phlegmon.
1901	Rixford (25)†	Cholecystostomy and 1 month later transduodenal excision. 8 months later cholecystenterostomy because of recurrence	Died 4 months after the last operation from recurrence.
1903	Koerte (38)* (Case 1)	Transduodenal excision and choledochopancreaticoduodenostomy. Drainage of hepatic and pancreatic ducts and gall bladder	Died 8 days after operation.
1904	Mayo Robson (25)†	Resection of duodenum and pylorus, suture of duodenum and pylorus, cholecystostomy with view to subsequent cholecystenterostomy	Died few days after operation.
1904	Koerte (38)* (Case 2)	Transduodenal plastic on papilla (excision of stricture). Drainage of pancreatic and hepatic ducts, and cholecystostomy 1¾ years later, resection of duodenum (circular and end-to-end suture), common and pancreatic ducts cut through, sutured together and reimplanted into posterior duodenal wall	Operative recovery. Patient well for 1½ years, then jaundice returned. Died third day after operation.
1904	Arnsperger (38)* (Voelker)	Transduodenal excision and insertion of choledochus. Drainage of hepatic duct	Died 2 days after operation from hæmorrhage.
1905	Koerte (38)* (Case 3)	Transduodenal excision and common duct reimplanted into duodenum	Operative recovery. Alive 3¾ years after operation.
1905	Vertroogen (38)* (Quenu)	Transduodenal excision	Died 11 days after operation from hæmatemesis and duodenal leakage.
1905	Cordua (38)*	Transduodenal excision, cholecystectomy and gastro-enterostomy	Operative recovery. Died 1 year later from recurrence.
1905	Mayo (38)* (Kausch)	Retroduodenal papillectomy, choledochoduodenostomy	Died after 8 weeks.
1908	Morian (38)*	Transduodenal excision, cholecystojejunostomy	Operative recovery. Died 2½ years later from recurrence.
1908	Cuneo (38)* (Hartman)	Transduodenal excision, reinsertion of choledochus, gastro-enterostomy	Died 4 days after operation.
1908	Navarro (38)* (Hartman)	Transduodenal excision, reinsertion of choledochus and pancreaticus	Operative recovery. Alive 2 years after operation. No recurrence.
1909	Kausch (38)*	Cholecystojejunostomy. 2 months later resection of duodenum and part of pancreas. Pancreaticoduodenostomy and gastro-enterostomy	Operative recovery. Died ¾ year later from cholangeitis.
1910	Stein (25)†	Duodenotomy. Soft, friable papillary mass surrounding papilla curetted away	Operative recovery. Patient alive 7 months later.
1910	Kraske (38)* (Oehler)	Transduodenal excision. Reinsertion of choledochus	Operative recovery. Severe hæmorrhage first day postoperative. After 23 months developed slight jaundice probably from a recurrence.
1910	Kelly (Lewis) 1920 (21)	Transduodenal excision. Reimplantation of choledochus	Operative recovery. Patient alive 9 years after operation.
1911	Hotz (38)*	Retroduodenal excision and gastro-enterostomy	Operative recovery.
1911	Slaymer (Kausch)	Retroduodenal excision, reinsertion of choledochus and pancreaticus. Choledochostomy and jejunostomy	Died after 3 days from cholæmic hæmorrhages.
1912	Hartman (Stakevitch)	Transduodenal excision with reimplantation of choledochus	Operative recovery. Recurrence 2 months after operation.
1912	Upcott (38)	Transduodenal excision and reinsertion of choledochus. Cholecystostomy	Operative recovery. Treated later with radium because glands suspected of being malignant were not removed.

*Reported by H. Upcott in 1912. †Reported by Outerbridge in 1913.

TABLE I.—Continued

Year	Surgeon	Operation performed	Result
1912	Oppenheimer (25)† (Enderlin)	Choledochotomy at first then resection of entire choledochus and surrounding indurated area. Hepatic duct sutured to duodenum. Cholecystectomy. Stump of pancreatic duct which had been cut through sunk into duodenal wall	Operative recovery. Died 1 year later from recurrence in liver.
1913	Hirschel (26)‡	Circular resection of the duodenum. End-to-end suture. Choledochoduodenostomy with tube. Resection of part of pancreas and pancreaticoduodenostomy and gastro-enterostomy	Operative recovery. Died 1 year later from recurrence.
1913	Alglave (Pollet) (28)	Transduodenal excision. Choledochostomy	Died 8 days after operation from cholæmia and anuria.
1913	Hartman (Stakevitch)	Transduodenal excision. Reimplantation of choledochus	Operative recovery. Patient alive 18 months after operation.
1913	Clermont (26)‡	Transduodenal excision	Died night of operation from hæmorrhage.
1913	Kleinschmidt	Cholecystectomy. Transduodenal excision	Died eighth day from peritonitis.
1914	Docq-VanPsever (26)‡	Transduodenal excision	Operative recovery
1914	Docq-VanPsever (26)‡	Transduodenal excision	Died fourth day postoperative from hæmorrhage.
1914	Wiede (26)‡	Transduodenal excision	Operative recovery.
1914	Wiede (26)‡	Transduodenal excision	Died from cholæmic hæmorrhages. At postmortem, no metastases found.
1916	Akerblom (26)‡	Transduodenal excision	Died after 8 days from cholæmic hæmorrhages.
1917	Akerblom (26)‡	Transduodenal excision	Died after 2 days from pancreatic hæmorrhage.
1918	Anschutz (3)	Transduodenal excision and reimplantation of choledochus. Pylorus occluded and posterior gastro-enterostomy. Cholecystostomy for 8 days	Operative recovery. Gained 30 pounds in 4 months.
1919	Lundblod (26)‡	Transduodenal excision	Died after 3 days from cholæmic hæmorrhages.
1919	Oliani (24)	Transduodenal excision and reimplantation of choledochus. Cholecystectomy with drainage	Operative recovery. Patient alive 4 years later.
1919	Arnsperger (4)	Transduodenal excision and reimplantation of choledochus. Hepatic drainage	Operative recovery. Patient died 6 months later from metastases.
1920	Brentano (6)	Transduodenal excision	Operative recovery. Nine months later local recurrence.
1921	Propping (30)	Transduodenal excision and reimplantation of pancreatic and choledochus ducts	Operative recovery. Patient alive 1 year later and gained 30 pounds in weight.
1921	Kleinschmidt (17)	Transduodenal excision. Drainage of duct of Wirsung	Operative recovery. Well 7 months later.
1922	Renshaw (32)	Choledochotomy, transduodenal excision (knife and cautery) cholecystduodenostomy	Died 9 days after operation.
1922	Bruett (7)	Cholecystectomy. Transduodenal excision and reimplantation of choledochus and duct of Wirsung	Died 2 days after operation from peritonitis.
	Bruett (7)	Transduodenal excision and reimplantation of choledochus and duct of Wirsung	Operative recovery. Patient alive ¾ of a year later.
	Bruett (7)	Transduodenal excision and reimplantation of choledochus and pancreatic duct	Operative recovery. Patient alive 6 months later.
1922	Tenani (36)	First operation: duodenotomy, posterior gastro-enterostomy, division of choledochus with implantation of proximal end into efferent duodenal segment. Suture of duodenum and closure of abdomen without drainage	Uneventful recovery.
		Second operation (one month later): duodenum mobilized and descending part resected. Diseased head of pancreas removed and pancreatic stump sutured into efferent duodenal segment and suture line protected with peritoneum	Postoperative reaction severe. Patient free from recurrence 3 years after operation.
1923	Dalla Valle (11)	Transduodenal excision with reimplantation of choledochus	Died 3 days after operation.
1923	Pozzi (29)	Duodenotomy. Excision of papilla with reimplantation of duct of Wirsung and choledochus. Cholecystgastrostomy	Operative recovery.
	Pozzi (29)	Choledochotomy. Transduodenal excision of papilla with reimplantation of choledochus and Wirsung. Cholecystgastrostomy	Died 6 days after operation from peritonitis.

† Reported by Outerbridge in 1913. ‡ Reported by Pallin in 1920.

TABLE I.—Continued

Year	Surgeon	Operation performed	Result
1923	Pozzi (29)	Duodenotomy. Excision of papilla with reimplantation of choledochus and duct of Wirsung	Operative recovery. Patient alive 3 years after operation.
1923	Beer (Case 1)	Transduodenal excision. Cholecystgastrostomy	Died in 10 hours from shock.
1924	Moschcowitz, A.V. (Case 2)	Choledochotomy. Transduodenal excision. Drainage to suture lines of common duct and duodenum	Died 5 days after operation from hæmorrhage.
1924	Tomaschewitch (37) (Abramoff)	Transduodenal excision	Death 11 days after operation from duodenal fistula.
1924	Abell (1)	First operation: Cholecystostomy. Second operation (2 months later): cholecystoduodenostomy Third operation (3 months later): duodenotomy; radium application against growth	Operative recovery. Operative recovery. Operative recovery. Patient alive 6 months after operation.
1925	Gohrbrandt (13)	Transduodenal excision with reimplantation of common bile and pancreatic ducts.	Operative recovery. Patient alive 4 months later.
1925	Muller (23)	Transduodenal excision	Operative recovery. Patient alive 1 year after operation.
1925	Cohen, Ira (Case 3)	Choledochotomy. Transduodenal excision. Cholecystostomy and drainage	Operative recovery. Died 11 months later from metastases.

The jaundiced patient has always been considered a poor risk. A glance at Table I will demonstrate the rôle of postoperative hæmorrhage in the causation of death for these patients are especially liable to postoperative oozing and active hæmorrhage. The blood of all patients with icterus should be tested for bleeding and clotting time before any operative procedure is undertaken. It may be advisable to supplement these two simple tests with a blood calcium time for if the latter is lower than the coagulation time, calcium administered as medication is quite effective in lowering the coagulation period of the blood. Walters (39) has had excellent results from the intravenous use of 5 cubic centimeters of a 10 per cent solution of calcium chloride given daily for 3 days preceding operation. Inasmuch as the majority of these unfortunate patients are quite debilitated and dehydrated, blood transfusions are especially indicated. Aside from their effect in diminishing bleeding, they provide good nourishment and excellent stimulation to a devitalized system. Nor is it amiss to "force feed" these patients on a high caloric carbohydrate diet, and; if any difficulty is experienced in getting them to drink sufficient amounts of fluid, a Murphy drip of 5 per cent glucose should be administered by rectum, for Mann (39) has shown that a high carbohydrate reserve is an excellent protector against "hepatic shock" which is apt to follow any operative procedure in the deeply jaundiced.

Local anæsthesia is to be preferred. If the temperament of the patient or the nature of the procedure contra-indicate this, nitrous oxide gas and oxygen should be chosen to secure adequate relaxation. From the work of Clairmont and Von Haberer (9) and Stahlei (35), it is well known that cases of common duct obstruction often develop oliguria, and may even develop a fatal anuria as in Alglane's case (see Case 4). The exact mechanism of this untoward complication is still obscure except that it seems directly related to some element in the jaundice, plus the added poisonous insult of a chloroform or ether anæsthesia. Pozzi (29) has employed spinal anæsthesia in 2 cases with excellent success.

The question of operative procedure depends upon the size, location, and relationship of the tumor to the surrounding anatomical structures. If the tumor lies deep in the choledochus or in the ampulla, its relationship to the duodenum and the pancreas can be appreciated properly only after the duodenum has been duly mobilized or sufficiently incised. Most surgeons are loath to open the duodenum, especially if marked jaundice exists, but there is no other way in which the pathology can be adequately demonstrated. If the tumor is deemed inoperable, a drainage oper-

ation of some character is indicated to relieve the unfortunate victim of the effects of bile retention and while the mortality of such procedures may appear high, some good palliative effects are often obtained. Cholecystostomy is undoubtedly the simplest procedure but not the least dangerous. The continual profuse, greenish drainage necessitates constant dressing, which is both distressing to the patient psychically and detrimental physically, because it robs the system of bile unless it is collected and fed by mouth through a stomach tube. Inasmuch as the gall bladder is invariably dilated, it may be effectively employed to transfer the flow of bile by anastomosing it by suture or Murphy button to some part of the gastro-intestinal tract. Payr (22) believes, and probably justly, that the duodenum is the most natural site for the neostomy, but it should be remembered that this will bring the biliary stoma quite close to the original tumor. Naturally, if a duodenotomy is performed for exploratory purposes, the opening should be used for the anastomosis (see Case 3). A cholecystogastrostomy is often effective; or, the jejunum can be utilized, and if combined with an entero-enterostomy provides quite an effective method of drainage.

TABLE II.—ANALYSIS OF SIXTY-FOUR CASES OF BILIARY OBSTRUCTION DUE TO CARCINOMA

	Cases	Mortality following operation—per cent
Location of carcinoma:		
Head of pancreas	39	35
Common bile ducts	14	63
Ampulla	9	66
Duodenum	2	66
Type of operation:		
Simple exploration	19	36
Cholecystostomy	10	70
Anastomosis	25	32
Cholecystectomy, choledochostomy and duodenotomy	10	70

It is quite instructive to review the operative results obtained in 64 cases of jaundice due to obstruction from carcinoma, admitted to the surgical wards of the Mount Sinai Hospital from 1916 to 1925, in which, on exploration either a radical or a palliative drainage operation was performed (Table II). Nineteen were simply explored and their wounds subsequently closed; 7 of these died, a mortality of 36 per cent. In 10, a cholecystostomy was made with a mortality of 70 per cent. Twenty-five were subjected to an anastomosis, the majority a cholecystgastrostomy, some a cholecystenterostomy, a few a cholecystoduodenostomy; 8 died, a mortality of 32 per cent. These figures, obtained from a small number of cases, should convince the skeptical that internal drainage operations are not attended with a risk so great as to make them prohibitive, and when once a cœliotomy is performed, the added risk of an anastomosis is practically negligible.

In those cases in which the gall bladder, because of previous disease, has become shrunken, and is unadaptable for anastomosis, or has been already removed, there is a theoretical possibility of uniting the suprapancreatic portion of the dilated choledochus to the side of the duodenum or the small intestine. Or, after division of the common bile duct and ligation of its distal end, to implant the proximal stump into the duodenum or anastomose it end-to-end or side-to-side. Kehr (16) was successful with a choledochoduodenoneostomy and Tenani performed a choledocho-enteroneostomy with success.

If upon opening the duodenum, the tumor is small and localized to the immediate region of the papilla, all that is necessary is its excision. This is obviously the simplest and easiest expedient. In this collected series of 59 cases, it was the procedure of choice in 53, in 50 through an anterior duodenotomy, in 3 through a retroduodenotomy. The general mortality was 44 per cent. In performing this so-called papillectomy, there are several technical features worth considering.

The duodenum must be properly mobilized and then opened through a vertical anterior incision. If the tumor is small and pedunculated it may be ablated with a scalpel, the endothermy knife or the actual cautery. This was all that was done in the cases of Stein (25), Moschcowitz, Beer, Cohen, Oppenheim (25), and others. If much of the duodenal wall has to be sacrificed in the cause of radicality,

the defect remaining should be carefully inspected for bleeding points, every effort being made for accurate hæmatosis.

The integrity of the common bile and pancreatic ducts is often disturbed by the removal of the papilla. In this collected series it was necessary to reimplant into the duodenum the choledochus in 26 cases and the duct of Wirsung in 14.

The reinsertion of the choledochus into the duodenum will be attended with an inflammatory reaction in greater or lesser degree and it is questionable whether an immediate free drainage of bile through this œdematous neostomy can be obtained. In order to insure a proper hepatic decompression, the question arises as to whether it might be advisable to combine papillectomy with a drainage operation. In this collected series, 29 cases in which a simple papillectomy was performed through an anterior duodenotomy had an immediate mortality of 38 per cent. In 24 cases in which papillectomy was combined with an additional drainage operation, either a choledochostomy, cholecystostomy, or cholecystenterostomy the mortality was 42 per cent. In spite of this slight increase in mortality it would seem more logical to employ a drainage operation when practical and especially in those cases in which the choledochus or pancreaticus has to be reimplanted. Because tension is certainly taken off the new suture line, bile flow is assured, and should stricture or local recurrence occur, as happened in the cases of Mayo (38) and Rixford (25), a secondary operation will not be necessary.

The opening in the anterior wall of the duodenum should be carefully closed with three layers of sutures and it might be advisable, to insure against the possibility of a duodenal fistula, as happened in the case of Tomaschewitch (37) and Vertroogen (38) and Case 4 in our series, to perform a posterior button gastro-enterostomy and pyloric exclusion by the Berg (5) method. A prophylactic gastro-enterostomy was done by Cordua (38), Cuneo (38), Hotz (38), Anschutz (3), and Tenani (36) with good results.

Occasionally, even though the surgeon may feel that he has removed all tumor tissue macroscopically, microscopic areas may be left behind as happened in Case 2. It might, therefore be advisable to implant radium seeds of either the platinum or gold variety, into the duodenal wall. Of course, the dangers of secondary perforation and hæmorrhage must be carefully considered. Upcott (38) in 1911 was the first to employ radium, for, after a papillectomy, some involved glands in the gastrohepatic omentum were left behind and 11 days after operation 5 milligrams of radium enclosed in a silver sheath attached to a probe were inserted into a cholecystotomy opening deep into the cystic duct. This was left in place for 6 hours and the next day the treatment was repeated for 4 hours. One month later the sinus healed, there was no further recurrence of the jaundice and the patient gained weight. More recently Abell (1), upon re-exploring a patient after a cholecystostomy, found an enlarged papilla, a specimen of which, upon examination showed an adenocarcinoma. A button cholecystduodenostomy was then performed. Three months later an exploratory cœliotomy was undertaken and no evidence of metastasis was found. A duodenotomy revealed the papilla increased in size from five-eighths to three-quarters of an inch and 25 milligrams of radium in two tubes were anchored against the growth with plain catgut and the tubes tied with heavy silk through the mouth. The radium was removed at the end of 12 hours. The patient was well 6 months later and weighed 150 pounds.

That simple papillectomy in selected cases may be sufficiently helpful is attested by patients who have survived 1 year or more, the longest case being the one recently reported by Lewis (21), in which a patient operated upon by Kelly was alive 9 years after operation; Oliani's (24) case survived 4 years, Koerte's (38) patient was alive 3¾ years, Pozzi's (29) 3 years, Hartman's (34) 1¾ years, Propping's (30) 1 year and Muller's (23) 1 year. To be sure these are not many, but they give some encouragement and stimulation for further surgical endeavor in this direction.

In other cases, because of the further extension of the tumor, papillectomy may not be sufficiently radical and to get beyond the

growth, a circular resection of the duodenum combined with a partial pancreatectomy may be necessary. This is a big operation requiring time and is rarely indicated, because the debilitated condition of these patients will tolerate in only exceptional instances a procedure so often associated with shock such as this. The rarity of cases surviving this operation are silent witnesses to its magnitude. After careful search of the literature, the celebrated cases of Halsted (38), Kausch (15), Hirschel (26), and Tenani (36) were the only ones found surviving the procedure. It would seem more practical to perform this operation in two stages; the first should be a drainage operation, primarily a means to rid the patient of his icterus, and thus better his condition for the more radical second part.

Halsted, who performed the first radical operation in 1898, resected a portion of the duodenum, restoring its continuity with an end-to-end suture anastomosis and reimplanted the choledochus and pancreatic ducts, at the same time doing a cholecystostomy. Three months later, a cholecystoduodenostomy was made. The patient died seven months following the primary resection, from recurrence. Kausch, in his case, did a preliminary cholecystojejunostomy and 2 months later performed a resection of the duodenum and part of the pancreas, doing a pancreatico-duodenostomy and gastro-enterostomy. Although the patient made an operative recovery, death occurred 9 months later from cholangeitis.

Tenani, more recently, at his first operation did an exploratory duodenotomy followed by a posterior gastro-enterostomy and after dividing the choledochus, implanted the proximal end into the efferent duodenal segment. He then sutured the duodenum and closed the abdomen without drainage. The patient made an uneventful recovery. At the second operation 1 month later, he mobilized the duodenum and resected the second part together with a diseased part of the head of the pancreas. The pancreatic stump was sutured to the efferent duodenal segment, the suture line being adequately protected by peritoneum. The patient was alive and free from recurrence 3 years after operation.

Hirschel performed his operation in one stage but few surgeons could complete this extensive procedure in his remarkable time of 1 hour. The procedure consisted of a circular resection of the duodenum with end-to-end suture, a choledochoduodenostomy with a tube, a resection of part of the pancreas with a pancreaticoduodenostomy and a gastro-enterostomy.

If the carcinoma arises definitely from the mucous membrane of the choledochus, radical extirpation is limited to those cases in which the tumor is situated just above the papilla. This can be appreciated only after the duodenum has been mobilized. A retroduodenal papillectomy was performed by Mayo (38), Hotz (38) and Slayner (26). Oppenheimer (25) resected the entire choledochus together with the papilla and reinserted the hepatic duct and pancreatic duct into the duodenal wall. The patient died 1 year later from recurrence. If the tumor occupies the pars pancreatica, excision is practically impossible.

When the mortality of either palliative or radical procedure in peripapillary carcinoma is considered, it would seem advisable to abandon all surgical endeavor, but on second thought, one is inclined to agree with Kocher (7) who said: "Some of these miserable individuals are relieved by palliative measures, some relieved for longer periods of time following the more radical procedures, and sometimes the worst which happens to them is not inconsistent with the obliviation of human suffering."

EIGHT CASES OF CARCINOMA OF THE AMPULLARY REGION OF THE DUODENUM FROM THE SURGICAL SERVICES OF THE MT. SINAI HOSPITAL 1915–1925

Three Cases of Carcinoma of the Papilla in Which Radical Operation Was Performed

CASE 1. A C., No. 41, male, age 34 years, was admitted to the hospital March 22, 1923. The family history and past history are irrelevant. The patient said that he had had jaundice for 6 months and during that period had lost 20 pounds. He had noticed that his urine was dark and his stools light, and then he complained of a pain in the right hypochondrium. Physical examination revealed a pronounced icterus and the gall bladder and liver were definitely palpable. A diagnosis of carcinoma of head of the pancreas was made.

The operation was done under local anæsthesia supplemented by gas and some ether. The gall bladder was found to be distended with bile but there were no calculi, and after the gall bladder had been emptied, a small, hard, movable tumor could be felt in the papillary region of the duodenum. The duodenum was mobilized and a transverse duodenotomy performed; the tumor was excised in two pieces without any bleeding. It was a hard tumor, covered with a mucous membrane, and about the size of a small cherry. Following the excision, there was a profuse flow of bile from the duct. No further obstruction could be felt with the probe. The duodenum was then sutured in three layers and reinforced with a peritoneal free fat flap. A rubber dam drain was placed into Morrison's pouch and a suture cholecystgastrostomy was done. The abdomen was closed in layers. After the operation, the patient showed signs of shock and possibly hæmorrhage and died within 10 hours. The pathological examination of the removed tumor revealed an adenocarcinoma of the papilla.

Case 2. S. H., No. 60-3, a female, age 54 years, entered the hospital January 9, 1924, and died January 18, 1924. She gave a history of a painless, intermittent jaundice, which recently had apparently increased. She had noticed that there was bile in her stools. On examination she looked very emaciated and deeply jaundiced; her gall bladder could be easily palpated below the free border of the ribs.

The abdomen was entered through a right rectus muscle-splitting incision. The gall bladder was found to be markedly distended while the common bile duct was about 2 inches in diameter. No calculi were found in the common duct but a few could be felt through the thin wall of the chronically inflamed gall bladder. A choledochotomy was performed and a mobile mass could then be felt at the ampulla. After a transverse duodenotomy, this mass was revealed to be a hard tumor of the ampulla. The tumor was excised and the duodenum and common duct were closed. Drainage was placed to the suture lines and the abdomen closed in layers. The patient died from hæmorrhage 5 days after the operation.

Autopsy. The body is that of a white female about 50 years of age. The skin is markedly jaundiced. The conjunctivæ are icteric. There is a linear high right rectus incision about 8 centimeters in length, through which numerous rubber dams, gauze, and tube drains project, and around this the wound area is hæmorrhagic and inflamed. Leading down from the abdominal surface the drains go to the duodenum. A gauze packing and a large rubber dam drain about 1 centimeter in diameter, filled with blood clot, goes down to the cystic duct. Around the cystic duct and the second and third parts of the duodenum, the parts are covered with a large amount of blood clot. This blood is localized to the operative field.

The lungs are voluminous and weigh 1140 grams. The pleuræ are smooth and glistening, except in the region of the left upper lobe, where there are numerous fibrous and fibrinous adhesions. On section the lungs are markedly œdematous and exude large amounts of a hæmorrhagic œdematous fluid. The trachea and bronchi are filled with a frothy œdematous fluid. The pulmonary vessels and the anterior mediastinum are negative. The posterior mediastinum contains a number of large, soft lymph nodes.

The heart weighs 400 grams. The pericardium is negative. There is a moderate amount of epicardial fat. The heart musculature is brown in color and somewhat flabby and shows cloudy swelling. All the valves are negative. The chambers of the heart are filled with dark, viscid blood clots. The aorta contains a number of atherosclerotic patches, some showing early calcification, especially in the first part of the arch. The intima is markedly bile-stained. The coronary arteries are negative, but there is a small accessory right coronary orifice present.

The œsophagus is negative. The stomach is large and distended; its wall is extremely thin and contains about a liter of dark, bloody fluid. The duodenum and the small intestines also contain a large amount of blood clot. The cæcum and ascending colon are markedly distended with gas and contain enormous amounts of fluid and clotted blood. The remainder of the colon and the rectum contain blood and tarry fæcal matter.

The liver is enlarged, weighing 2,020 grams. Its surface is smooth, dark green in color, and it is extremely firm in consistency; on section, the parenchyma was found firm and markedly bile stained. The bile ducts are dilated. The gall bladder also is dilated and contains four facetted, smooth surfaced bilirubin calcium stones. The cystic duct is also dilated throughout its course. The hepatic and common ducts are markedly dilated, the common duct measuring about 2 centimeters in diameter throughout its course. There is a suture line which extends for a distance of about 2 centimeters along the common duct and then down across the second and third parts of the anterior surface of the duodenum for a distance of 3 centimeters. This suture line, the remains of a choledochotomy and a duodenotomy is competent and there is no leakage. On the inner surface of the duodenum, the papilla of Vater has been removed and the common duct enters the duodenum with its orifice about 1 centimeter in diameter. There is a large area of denuded mucous membrane in the duodenum which extends proximally in this structure for a distance of about 3 centimeters. This ulcerated area, which is surrounded by small fragments of inflammatory and tumor tissue, is the site of removal of a carcinoma of the papilla of Vater which extended to the duodenal mucous membrane. The denuded area is about 3 centimeters in length and 1.5 centimeters in width. There are still present numerous bits of tumor tissue, and at the proximal end of this wound there is a small papillary nodule, firm in consistency, neoplastic in appearance. The base of this area and the surrounding tissue is markedly hæmorrhagic and

inflamed. At the orifice of the common duct on the duodenal surface, there is a catgut hæmostatic suture which is loose and lies open in the duodenal lumen. On section, the neoplastic area extends through the coats of duodenum and seems to involve the anterior surface of the head of the pancreas.

The pancreas is small, firm, fatty, fibrous in consistency and shows no gross pathological change except for a slight involvement as described above.

The spleen is small, weighing 100 grams. Its capsule is gray in color, wrinkled, and shrunken. On section, the organ is pale pink in color, shows marked shrinkage, and is fibrous.

The adrenals are negative, grossly.

The kidneys together weigh 300 grams. Beneath the capsules which strip easily, the kidney shows a slightly granular surface. They are injected. On section the markings are distinct, pale in color and show a few petechial hæmorrhages in the pelvis. The ureters and bladder are negative. The uterus and tubes are negative. The cervix is small. Ovaries are small and fibrous.

Microscopic examination. The liver shows bile stasis. There is an increase in fibrous tissue and periportal spaces. There is an adenocarcinoma arising from the papilla of Vater. There is a postmortem change in the pancreas which shows areas of abscess formation. There are bile pigment casts in the tubules of the kidney. There is postmortem change in the adrenals.

Diagnosis. (Operation-choledochotomy and duodenotomy for cholelithiasis and carcinoma of papilla of Vater): postoperative hæmorrhage into intestines; cholelithiasis.

Cause of death. Postoperative hæmorrhage.

CASE 3. A. M., No. 258996, female, age 44 years; entered the hospital September 18, 1925, and left the hospital 5 weeks later. The only facts of importance in her past history were an appendicectomy and oophorectomy done 20 years previously. The onset of her present illness dates back 4 years when attacks of chills started unaccompanied by fever, but associated with vomiting. These attacks occurred quite frequently from then on. For the past 5 weeks there was a progressive jaundice together with acholic stools, loss of 20 pounds in weight and a general weakness. On swallowing, patient experienced a sense of oppression in the epigastrium.

Physical examination showed an emaciated, icteric woman, weighing 107 pounds with scratch marks on the skin and several areas of ecchymosis. There was a midline hypogastric scar in the abdomen and some fullness in the right upper quadrant where a smooth cystic mass was felt. The free edge of the liver and the lower pole of the right kidney were palpable.

The blood picture and blood chemistry were normal. The Wassermann was negative. The bleeding time was 8¾ minutes and the coagulation time 9 minutes. The Van den Bergh test was positive by the direct method, the indirect was 1–50,000. The urine contained bile and a faint trace of albumin. The stools were clay colored, containing neither bile nor urobilin. Operation was done September 18, 1925, under nitrous oxide and oxygen anæsthesia. The gall bladder was distended with white bile which was emptied by aspiration. No calculi were found in the gall bladder or ducts; the pancreas was normal. The common duct was opened and probed, and in the duodenum a mass was felt. The duodenum was opened through an incision in the anterior wall, and a tumor the size of a cherry was located at the site of the ampulla of Vater. The entire tumor was readily delivered outside the lumen of the gut; the mucous membrane about it was circumscribed and the intramural portion of the common and pancreatic ducts was exposed by traction and thus cut across. The mucous membrane of the duodenum was then sutured with fine chromic gut to the cut edge of the ducts; after this a probe could be readily passed from the duodenum up into the common duct. The duodenum was closed in four layers, the common duct was sutured and the gall bladder was drained.

Postoperative course. The first 8 days were uneventful; the wound healed by primary union. On the ninth day a hæmatoma developed in the wound and the following day a large amount of blood was noted in the stool. A 500 cubic centimeter citrate transfusion was given. The bleeding time before the transfusion was 11¾ minutes, the coagulation time 10½ minutes; after the transfusion these were 5 minutes and 4½ respectively. Further convalescence was uninterrupted. One month after the operation a normal concentration of pancreatic ferments and clear bile were obtained by the duodenal bucket. The patient's weight increased and she left the hospital 5 weeks after the operation.

Subsequent course. For 5 months the patient remained symptom free. Then in March, 1926, she began to have severe pain over the upper end of the sternum. In May she was admitted to the Montefiore Hospital, at which time she had bone metastases in the sternum, skull, lumbar spine, ilium, and left humerus. Up to the time of her death, August 2, 1926, she showed no sign or symptom of local recurrence or abdominal metastases. No postmortem examination was permitted.

Five Cases of Carcinoma of the Papilla in Which Palliative Operation Was Performed

CASE 4. E. H., a female, age 32 years, was admitted to the hospital December 8, 1919, and died December 28, 1919. The patient complained of attacks of severe pains in the right upper quadrant accompanied by fever and chills. These attacks started 4 months ago. Two months ago she became jaundiced. She had no clay colored stools, but she has lost 20 pounds in weight. Physical examination shows an emaciated, acutely ill woman, with tenderness in the right upper quadrant where an indefinite mass is felt.

Operation was done December 9, 1919. Pericholecystic adhesions were found. The common duct is enormously dilated. There is a tumor mass

involving the duodenum and the head of the pancreas. In the duodenum there is a small ulcer. The head of the pancreas is freely movable and there is no glandular involvement. Procedure: cholecystectomy, choledochostomy, duodenotomy.

On December 14, 1919, anuria developed with collapse. On December 25, 1919, a duodenal fistula was found, and in spite of stimulation the patient died 3 days later.

Autopsy. Body is that of a female, age 32 years, rather poorly nourished and anæmic. Moderate rigor mortis is present. The skin shows no discoloration anywhere. There is a postoperative scar about 4 inches long over the right rectus muscle. At the upper end of this scar there is an opening about 1 inch long. Below, this, the wound is healed. The opening communicates with the peritoneal cavity and there is a fairly walled off sinus admitting two fingers and extending anteriorly and above the liver.

The lungs lie free. The right lower lobe is atelectatic. On section this part cuts firmly and does not seem crepitant. Remainder of the lung appears normal.

The pericardium is normal. The valves and endocardium appear normal. The walls are not thickened. The myocardium appears rather pale. The aorta near the aortic valve shows a few atheromatous patches.

There are adhesions of intestines about the sinus previously described. On opening the abdomen, the remainder of the peritoneum appears quite normal. There is no free fluid present.

The stomach and intestines appear normal. About 1.5 inches below the pyloric sphincter there is seen a thickened area of mucosa about the size of a half dollar apparently surrounding the papilla of Vater. In the ampulla itself is seen a small polypoid mass the size of a split pea and of similar appearance to the thickened mucosa of the duodenum. The duodenum itself appears dilated. On the anterior wall of the duodenum is an opening about ¾ of an inch long (due to duodenotomy) which communicates with the abscess cavity. The remainder of the intestines are collapsed.

The gall bladder has apparently been removed. There is an opening about ¼ inch long, near the upper part of the common bile duct. Below this the common bile duct is dilated to the thickness of the index finger.

The liver is apparently not enlarged. On section the lobules appear quite distinct and the liver has the appearance of a chronically congested organ. The liver is not icteric.

The pancreas is apparently normal throughout. The head of the pancreas does not seem to contain any neoplasm. An accessory pancreas, the size of a half dollar is present in the anterior wall of the duodenum. The spleen is apparently normal.

The kidneys are moderately enlarged. The capsule strips easily; on section the cortex appears extremely pale and the striations are poorly marked. The medulla has a somewhat purplish color.

The adrenals are apparently normal.

Diagnosis. Adenocarcinoma of ampulla of Vater and duodenum. Accessory pancreas. Obstructive jaundice. Duodenotomy.

Microscopic examination. The mucosa and part of the muscularis of the duodenum is involved by an adenocarcinoma which in places presents a colloid appearance. The greater part of the wall of the duodenum is replaced by an adenocarcinoma; only in a few places strands of the muscularis are involved. The accessory pancreas itself does not appear to have given rise to the neoplasm, but rather appears to have been invaded by the carcinoma. The islands of Langerhans are exceedingly small. This part of the organ does not appear to contain any carcinoma. In the tail of the pancreas no carcinoma is present. The liver shows moderate passive congestion. The centers of the lobules and the cells about the hepatic veins contain brown pigment. This is also present in the Kupffer cells in these regions.

CASE 5. A. K., a female, age 47 years, was admitted to the hospital January 29, 1922, and died February 3, 1922. The patient complained of progressively increasing jaundice during the past 2 months. She had lost 20 pounds in weight, her stools were clay colored, her urine dark, but there was no pain. There was marked anorexia. Physical examination shows a markedly jaundiced emaciated woman, whose liver and gall bladder are distinctly palpable.

Operation. The abdomen was opened through a right rectus incision. The gall bladder and common duct were found to be greatly dilated. A cholecystostomy was done with liberation of much clear fluid; then a choledochotomy. A probe can be passed into the duodenum without any difficulty. The pancreas is enlarged but not hard. A tube is placed in the region of the choledochostomy. Closure of the abdomen was done in layers. The patient died 8 hours later from shock.

Autopsy. The body is that of a middle aged woman, and shows incomplete rigor mortis, no petechiæ. The skin and mucous membranes are intensely icteric. The œsophagus is negative. The trachea contains a small amount of frothy, pinkish fluid. The pleural cavity is free from fluid and adhesions. The lungs are well aerated. There is moderate congestion at the bases. The pericardial cavity contains a normal amount of pericardial fluid. The heart is flabby. The musculature is light brown in color. The valves are negative. The coronaries show a moderate amount of atherosclerosis. The aorta shows a small amount of subintimal fatty infiltration. The elasticity is good. There is an 8 inch incision in the midepigastrium, the lower two thirds of which is sutured. The upper angle contains 2 rubber tube drains, one of which is inserted into the common duct and the other into the gall bladder. The one into the gall bladder contains a blood clot. The other into the common duct contains thick, black bile. When the peritoneal cavity was opened

a very large amount of blood clot was found over the entire right lumbar gutter, covering the anterior surface of the right lobe of the liver. The surface of the liver is smooth. A cut section shows a greenish surface. The biliary passages appear to be dilated. The hepatic and portal veins are negative. The gall bladder is found markedly distended with blood clot. There are no stones present. The cystic duct was investigated and found patent and dilated. The hepatic duct is patent and somewhat dilated. The interhepatic portions of the hepatic duct are found to be somewhat dilated and filled with a thick black bile. The common duct is drained by a large rubber tube. It is considerably dilated. The papilla of Vater appears prominent and has the shape of a nipple. It is œdematous. A probe can be passed through the opening only by force. There is a small mass of tissue (1 millimeter) about the mouth which feels harder than the surrounding tissue and on cut section has a whitish appearance. There is an enlarged, hard lymph node along the course of the cystic duct. The head of the pancreas feels very hard and on cut section has a deep, yellowish color. It cuts with a great deal of resistance, but appears to be fibrosed pancreatic tissue. The lobulations are preserved. There are other such areas throughout the pancreas but they do not appear to be new-growths. The spleen weighs 120 grams. The capsule is dense. On cut section, it shows increase in fibrous tissue. The kidneys together weigh 300 grams. Capsule strips with ease revealing a few small cysts. Cut section shows marked icteric tinge of the entire surface. The adrenals appear to be negative. The stomach contains a small amount of thick light yellowish fluid. There are no lesions present in the mucosa. The intestinal tract reveals no blood.

Microscopic examination. The papilla of Vater shows carcinoma, which in the deeper portion is spheroidal in type. There is one area of a typical squamous cell carcinoma. Transitions from squamous to spheroidal type are to be seen. The lymph node along the cystic duct shows squamous cell carcinoma. There is a moderate amount of hypertrophy of the heart muscle. The pancreas shows small amount of intra-acinar fibrosis. The liver is somewhat fatty. Glisson's capsule is infiltrated by numerous large cells. The biliary capillaries are moderately distended. The periportal tissue is increased in amount. The biliary ducts appear to be moderately dilated. The spleen is congested. The vessels show marked thickening. The Malpighian corpuscles are diminished in size. There is a distinct increase in reticular tissue. The mucosa of the gall bladder is atrophic; the submucosa, muscularis, and serosa are infiltrated by numerous large round cells. The larger vessels along the serosa contain organized thrombi. Hæmorrhage has taken place into the deeper layers of the muscularis.

Diagnosis. Squamous cell carcinoma of the papilla of Vater. (Cholecystotomy and cholodochotomy for hydrops of the gall bladder and common duct obstruction.)

Cause of death. Postoperative hæmorrhage into the peritoneal cavity.

CASE 6. No. 60-6, a male, age 50 years, complains of burning and discomfort in the epigastrium together with loss of 5 pounds in weight in past 3 months. During past 3 weeks he has been jaundiced. Physical examination discloses a markedly jaundiced man, whose liver is palpable at the umbilicus.

Operation was done under nitrous oxide gas and oxygen anæsthesia. The liver was enlarged to the umbilicus. The gall bladder was increased in size but there were no stones. The common duct in the region of the papilla felt nodular. The stomach was negative on examination. The operative procedure consisted in a button anastomosis between the gall bladder and the first portion of the duodenum. The abdominal wall was closed in layers. Patient's recovery was uneventful. Jaundice had practically disappeared at the time of discharge 2 weeks after operation.

CASE 8. No. 41A-9, a female, age 48 years, admitted to the hospital February 9, 1923, and discharged March 3, 1923. The patient complained of pains in the right upper quadrant radiating to the shoulder. There had been four attacks of this in the past year, each attack lasting for 2 hours, and the last one occurring 5 weeks before admission, was followed by jaundice, clay colored stools, and dark urine. She had lost 40 pounds in weight. Physical examination showed a jaundiced, middle aged woman, slightly emaciated, with a globular movable mass in the right upper quadrant. The liver could be felt four fingers below the costal margin.

The abdomen was opened by right pararectus incision. The liver was enlarged, hard, and smooth. The gall bladder was markedly distended; in the papillary region was a hard mass which felt like a new-growth. In the region of the foramen of Winslow were a few small, hard masses and enlarged glands about the common duct. A suture cholecystgastrostomy was performed. The postoperative course was uneventful, and the patient was discharged improved.

CASE 8. A. S., No. 160934, a male, age 58 years, was admitted to the hospital August 14, 1916, and transferred to surgical service on August 24, 1916. He gave a history of painless but progressive jaundice, which had started 4 weeks before his admission, with pruritus, acholic stools, and a loss of 25 pounds in weight. On examination he was found to be poorly nourished and jaundiced, the liver was found palpable 3 finger breadths below the costal margin, and there was a fullness in the epigastrium.

An operation was done under nitrous oxide gas and ether anæsthesia. The abdomen was entered through a 5 inch right rectus splitting upper incision. The gall bladder was found to be dilated and the common duct tremendously so. Near the head of the pancreas a small mass could be felt; one portion of this was exceedingly hard and suggested the feel of a stone on needling. The duodenum was exposed and opened; a small carcinoma of the papilla of

Vater was found and a part excised for pathological examination. A probe could be easily passed into the common duct. As a purely palliative procedure, a button cholecystduodenostomy was performed. The gall bladder which was opened was found to contain a very thin colorless mucoid material. Through a rent in the omentum the posterior wall of a very small stomach was anastomosed by Murphy button to the nearest jejunal loop, and the rent sutured to margin. The pylorus was excluded with Pagenstecher exclusion stitch. Two rubber dam drains were left in the upper angle, and one packing in the region of the cholecystduodenostomy. The abdomen was closed with heavy through-and-through silk sutures. An intravenous infusion of saline (16 ounces) was given immediately. At the close of the operation, the patient's condition was fair. The patient died 4 days after the operation. Pathological report of specimen: adenocarcinoma.

Autopsy. There is very intense icterus of the skin and all structures. The peritoneal cavity contains no free fluid. There is a Murphy button cholecystoduodenostomy in good condition and a posterior no loop Murphy button gastro-enterostomy, also in good condition. The omentum is thickened and inflamed, and adherent to the structures about the gall bladder and duodenum. The stomach is distended and at the pylorus there is a linen thread occlusion ligature which completely closes the lumen. The duodenum was opened along the anterior wall; at the site of the papilla of Vater is a soft cauliflower like mass, 3 by 4 centimeters in size which projects 2 centimeters. The bile ducts are very much distended and thickened and contain a heavy, brownish, bile stained material. A probe was passed down the common duct in to the duodenum through the ducts above described. The pancreas is normal in size On gross examination, however, the pancreatic duct is found to be markedly dilated. A probe passed down into it also passed the duodenum through the center of the tumor.

The liver is somewhat smaller than is normally found. It is dark green in color and markedly icteric. Bile ducts contain thick, brownish, bile-stained material. The transverse colon proximal to the region opposite the opening in the transverse mesocolon, where the gastro-enterostomy is situated, is very dark red in color and has the appearance of a beginning gangrene. All of the intestine, including the small intestines above this area are tremendously distended; beyond this area, they are collapsed. A careful investigation of the vessels in the transverse mesocolon revealed no thrombi in any of them.

Diagnosis: carcinoma of papilla of Vater.

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CLINICAL SURGERY

FROM THE UNIVERSITY OF CALIFORNIA HOSPITAL

NEPHRECTOMY

By FRANK HINMAN, M.D., F.A.C.S., San Francisco

THERE is a certain charm about surgery of the kidney. It exercises the imagination, uses the intellect, requires judgment, and benefits by skill and experience sufficiently to make it fascinating. Interest is diversified. Problems that often require a high degree of intelligent solution arise throughout the course of almost every case. The problem of diagnosis comes first with its highly technical methods of examination, in the use and proper interpretation of which both training and experience are required. Then arises the problem of preparation for surgery, such as catheter drainage or nephrostomy, and the problem of delay against early operation. Finally, the problem of choosing the best surgical attack is a very interesting and vital one. There are commonly two kidneys. Disease may be unilateral or bilateral but, if unilateral, the healthy side may become affected later, so that conservation of renal tissue is in order so long as it promotes the general interest of the patient. Nephrectomy is radical but is often the only surgery that serves the patient best. The surgeon chooses for the patient the conservative or radical way, and the result in time proves the correctness or error of his judgment. The satisfaction of exact diagnosis and curative treatment is no greater in any other field of surgery.

The possession of two kidneys and predominance of unilateral disease makes nephrectomy the commonest operation on the kidney. Radical removal is required in tumor and tuberculosis of whatever stage. But nephrectomy for stone, for hydronephrosis, for solitary cyst, for pain or infection, means that the lesion is hopelessly advanced. Early diagnosis and treatment will diminish the frequency of nephrectomy in these cases.

The first reported nephrectomy in America was by Wolcott in 1861; in Europe, by Gustav Simon, in 1869. Simon killed his second patient by digital exploration during convalescence. The fatality following the fourth nephrectomy case reported by von Bruns in 1878 delayed surgery of the kidney another decade or until antisepsis was firmly established. Even then the mortality was high[1] until with more accurate diagnosis, better preparation for operation, improvement in judgment of selection of cases and in surgical technique and methods, nephrectomy has come to be one of the safest of major operations (1 to 10 per cent, varying with the disease and the operator).

The conditions for which nephrectomy is most frequently indicated are renal tuberculosis, renal tumors, and calculous pyonephrosis. The risk will vary with the condition of the patient. Age has very little influence, other things being good, but complications of the cardiovascular system, of the lungs, etc., must be as carefully considered as in all major surgery.

First consideration belongs to the opposite kidney. Removal of a solitary kidney should never occur and removal of a diseased hypertrophic kidney, when its mate is infantile, causes the death of the patient in most instances. Removal of one kidney, when the opposite one is also diseased, calls for a high degree of judgment. In such bilateral conditions treatment of the less injured side by catheter drainage, nephrostomy, removal of stones, plastic operations, ureteral transplantation, should, in most instances, precede nephrectomy. In renal tuberculosis the mortality will be lowest in early lesions confined to one side, highest in cases with bilateral disease or generalized pulmonary and genital tract involvement. Of 847 cases reported between 1902 and 1908 by various European surgeons, there was an operative mortality of 11.1 per cent. In 190 nephrectomies for unilateral renal tuberculosis, Persson[2] (Stockholm) in 1925 reports an operative mortality of 7.3 per cent; O'Neil[3] (Boston) of 3.8 per cent in 103 cases. Of our own 70 cases, there are

[1] Brodeur reports that up to 1890 the mortality of nephrectomy was 58 per cent.

[2] Persson. Ann. Surg., 1925, lxxxii, 526–551.

[3] O'Neil. Cabot's Modern Urology, 1924, p. 572. Philadelphia: Lea & Febiger.

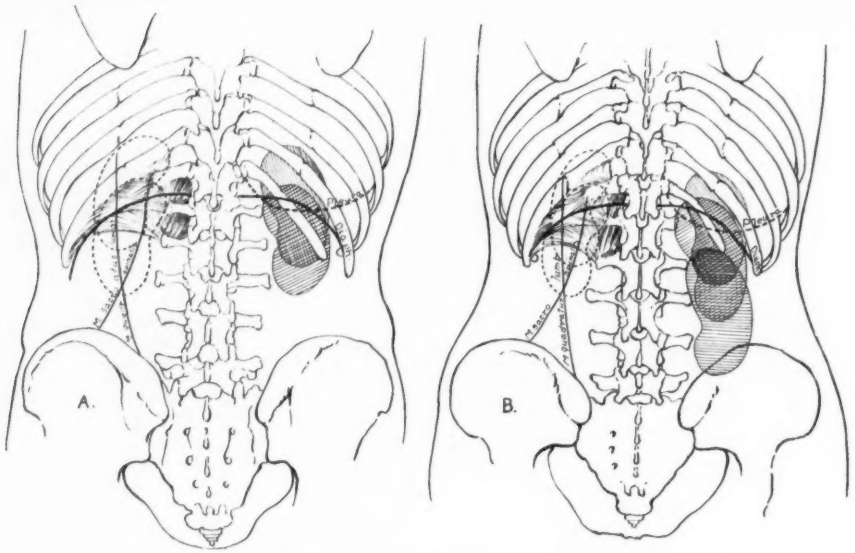

Fig. 1. The position of the kidneys: *A*, In the male adult. *B*, In the female adult. The heavy curved line on both sides (diaph.) shows the usual limits of attachment of the diaphragm, the dotted line, on the right only (pleura), the usual extent of reflection of the pleura. On the left side, a short twelfth rib is shown. The vertical lines on the left that cross indicate the outer borders of the sacrospinalis and quadratus lumborum. The costovertebral ligament beneath these muscles is divided in the oblique lumbar incision when better exposure of the kidney is required. The usual variations in the kidney position are shown. (After Brocdel.)

two deaths in 60 unilateral, a mortality of 1.6 per cent, 5 in 10 bilateral, or 50 per cent; 2 deaths (one autopsy) were due to embolism, a cause of death in nephrectomy for tuberculosis never before reported according to O'Neil. In tumor of the kidney, the operative mortality is high. The risk is greatest with advanced and large tumors, smallest with early localized growths. In 24 cases of Squier[1] it was 50 per cent; in 62 cases of Braasch,[2] excluding 22 explorations, 11 per cent; in 268 cases of Paschen,[3] 19 per cent. Personally we have had one death (child) in 12 cases. In pyonephrosis, the virulence of the infection and general resistance of the patient influence the result even with a perfectly healthy kidney on the opposite side. In 40 cases of pyonephrosis, we have had 2 deaths (5 per cent); in 5 cases of acute suppurative nephritis, 2 deaths (40 per cent). Deaths following our 200 nephrectomies were due to complications that follow surgery anywhere, such as pulmonary or cerebral embolism (2 cases, renal tuberculosis), pneumonia (1 case, pyonephrosis), embryonal adenocarcinoma (2 bilateral renal tuberculosis, 1 pyonephrosis), surgical shock or cardiac failure (4 cases). One case of pyonephrosis died of carcinomatosis (stomach undiagnosed) following nephrectomy (autopsy). The immediate com-

Fig. 2. The usual variations in the intra-abdominal relations of the kidneys. The adrenals have a separate capsule unattached to that of the kidneys and rarely interfere with delivery.

[1] Squier. Boston M. & S. J., 1909, clxi, 547.
[2] Braasch. J. Am. M. Ass., 1913, lx, 274.
[3] Paschen. Arch. f. klin. Chir., 1915–16, cvii, 213.

Fig. 3.

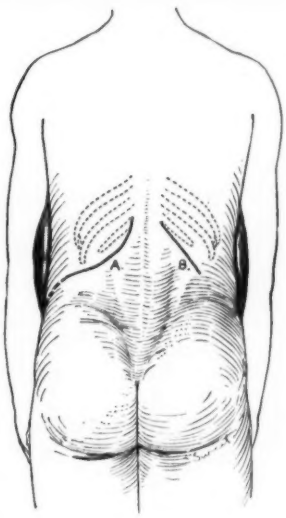

Fig. 4.

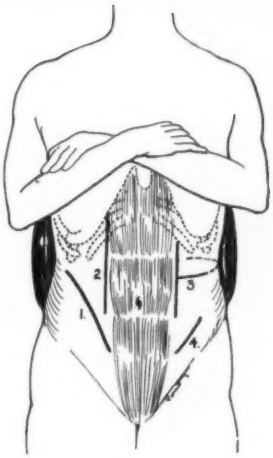

Fig. 5.

Fig. 3. The lateral position of the patient with opposite leg well flexed, corresponding one straight, arms folded in front and pad under the lower margin of ribs. Usual oblique lumbar incision is shown.

Fig. 4. The posterior position of the patient: *A*, Long type of incision for large exposure; *B*, short incision for nephropexy.

Fig. 5. The anterior position of the patient for the abdominal route of exposure. *1*, The oblique semilunar incision; *2*, vertical rectus; *3*, the antero-lateral; *4*, the inguinal.

plications were especially renal insufficiency (2 cases, bilateral tuberculosis), particularly oliguria and acidosis, hæmorrhage (2 cases, both nephrectomy for hæmorrhage following nephrotomy for stone), and sepsis (2 cases, pyæmia of acute suppurative nephritis), and the local surgical injuries to pleura (7 cases—none fatal), vena cava (none), peritoneum (none), intestines (none), pancreas (none), spleen (none), liver (none), or adrenals (1 case, complete recovery, probably adrenal hæmorrhage, very rapid pulse for 7 or 8 days immediately following operation for renal tuberculosis, no hæmorrhage in wound which was drained). In a properly performed nephrectomy, the utmost precaution is needed to prevent and minimize these renal complications.

Excluding 6 deaths of bilateral and miliary tuberculosis, the two deaths following nephrotomy for stone, in which nephrectomy was attempted as a last resort, the death 2½ months after operation from carcinomatosis and the two pyæmia cases, leaves an operative mortality for all cases of between 1 and 2 per cent.

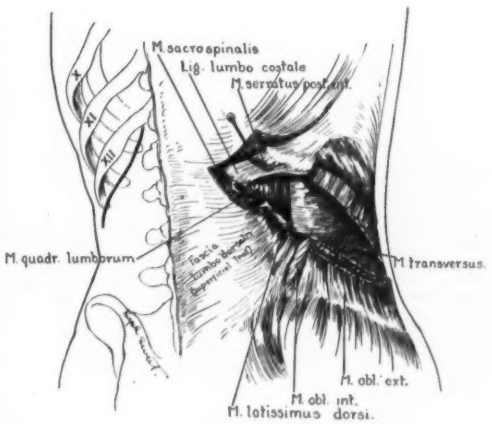

Fig. 6. The muscle layers divided by the oblique lumbar incision. First layer: latissimus dorsi, sacro-spinalis, external oblique. Second layer: serratus posticus inferior, internal oblique. Third layer: transversalis, quadratus lumborum, costovertebral ligament.

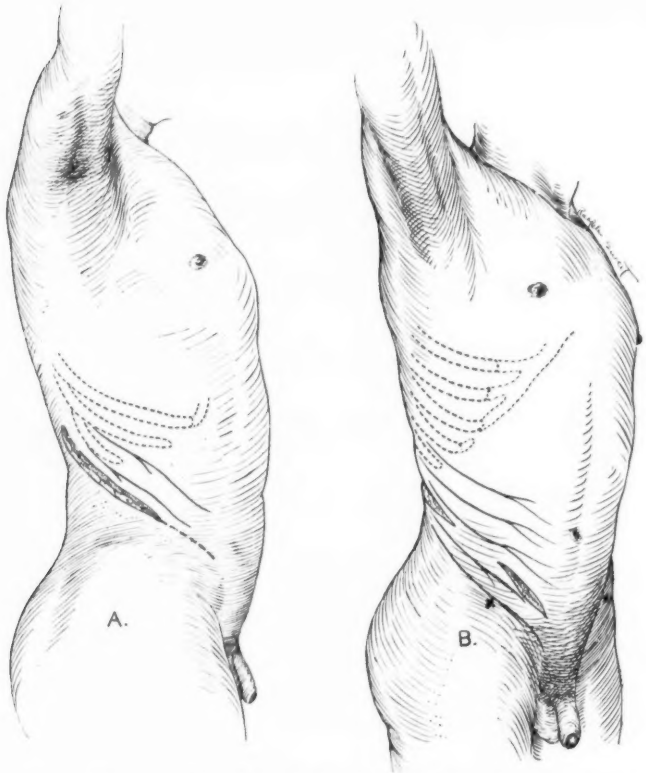

Fig. 7. The general line of distribution of the blood vessels and nerves, and how the incision should follow between.

One of the most troublesome postoperative conditions following nephrectomy is meteorism. Traction on the renal pedicle may set up nerve reflexes, producing temporary bowel stasis, or important nerves may be cut or injured by the incision and produce a unilateral muscle paralysis of the abdominal wall. The nephrectomized patient is prone to balloon up full of gas. Rarely is the condition serious but it is often very disagreeable. Purging beforehand is apt to promote its occurrence. It is found less frequently and is of milder degree in patients cleansed by a simple enema without catharsis, and given fluids freely up to within one hour of operation. Pre-operative administration of pituitrin or eserine is advised by some.

Oliguria and acidosis are minimized by providing plenty of fluids, giving them freely by mouth up to the time of operation, by hypodermoclysis during the time of operation, and by rectum or hypodermoclysis or intravenously immediately after. It is our custom to give 500 to 1000 cubic centimeters by needles in the thighs while the patient is on the operating table. This procedure is valuable particularly in children. The urine should be tested for acetone and diacetic acid after operation and glucose and bicarbonate of soda given freely if found. Weeks' method enables one to give fluids comfortably per rectum.

ANÆSTHESIA

Proper anæsthesia is one of the most important factors of a low surgical mortality. Pneumonia should be a very exceptional cause of death following nephrectomy. The almost universal use of nitrous oxide and oxygen in place of ether or chloroform as a general anæsthetic has contributed largely to the safety of nephrectomy. When a

general anæsthetic is contra-indicated, as in pulmonary tuberculosis, a high spinal or paravertebral block is quite satisfactory. When properly given, much better relaxation is obtained than with gas and oxygen. The only objection is its short duration, but this is not serious for the average operation which is well short of an hour. When the operation requires more time, the nerve block can be supplemented by the gas-oxygen.

Injury of anatomical structures at the time of operation is best avoided by a thorough understanding of the surgical anatomy involved.

THE POSITION OF THE KIDNEY

The kidneys lie in mid-back just below the diaphragm in retroperitoneal niches formed by the bodies of the vertebræ, the muscles of the back, and the last two ribs. Commonly the right is somewhat lower than the left (Fig. 1), because of the larger right lobe of the liver, and both kidneys are somewhat lower in women than in men (Fig. 1, *A* and *B*). The relation to the twelfth rib varies considerably because of differing degrees of ascent of the kidneys themselves and of the many variations in length and position of this last rib which may be so short (Fig. 1*B*, left) as to run horizontally and be parallel to the transverse processes, or be wanting altogether. The individual's condition in this respect should be known ahead of operating as a control of the type of incision for exposure, and it is a good rule always to have an X-ray picture of the patient exhibited in the operating room. The condition of a twelfth rib is of importance also in its relation to the diaphragm, pleura, and the costovertebral ligament, for frequently free division of this ligament is needed so that the rib can be pulled up out of the way to give good renal exposure. Some surgeons prefer resecting a rib subperiosteally with the purpose of better protection of the pleura. The muscles of the diaphragm are frequently wanting or poorly developed between these points of attachment at the back, particularly when the twelfth rib is short or wanting, so that foreknowledge of the situation is a great help in protecting the rather fragile pleura from injury when the question of division of the costovertebral ligament arises. The usual relation of the pleura to the twelfth rib is shown in Figure 1, the reflection on the left in *B* would be well below the short twelfth rib on this side. A too high incision—near the eleventh rib—would make injury of the pleura more likely. The variable relations to the kidneys of the abdominal organs lying in front are shown in Figure 2. Injury to some of these rarely occurs and is usually due to catching a part of the organ in a clamp when

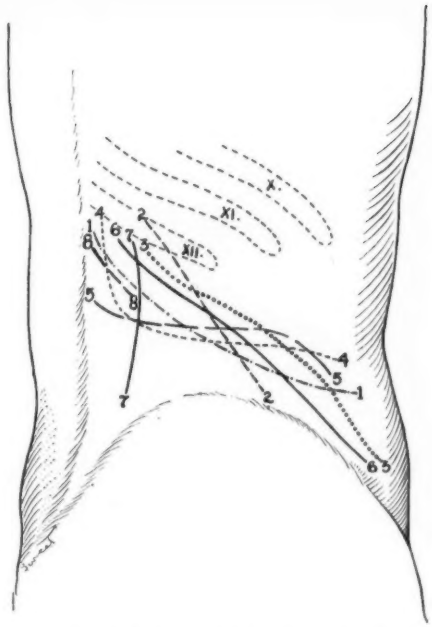

Fig. 8. Various types of lumbar incisions that have been used in kidney surgery. *1*, Mayo's. *2*, Czerny's or Edebohl's. *3*, v. Bergemann's or Lissone's. *4*, Koenig's. *5*, Peon's. *6*, Oblique-lumbar. *7*, Simon's. *8*, Superior lumbar trigonal.

placed on the pedicle or closed blindly or carelessly to stop bleeding. The commonest accidents of this kind have been injury to duodenum or pancreas which have been caught by the tip of a pedicle clamp. We have had one duodenal fistula as the only injury to abdominal organs and this one closed spontaneously.

THE ROUTE OF EXPOSURE

The extraperitoneal lumbar is the route of choice in every ordinary nephrectomy, and the lateral, on kidney pad or mechanical horse, opposite knee fully flexed and corresponding leg straight, is the best position (Fig. 3). Where it is desired to examine or treat the opposite kidney, or an exploratory of both is required which nowadays is almost unheard of, the posterior position on pad or horse is preferable to turning the patient (Fig. 4). Many surgeons prefer this position (with the anterior) for all operations on the kidney (Kidd of London). My experience with it in several cases has been that it gives a very good exposure. It is particularly applicable for bilateral

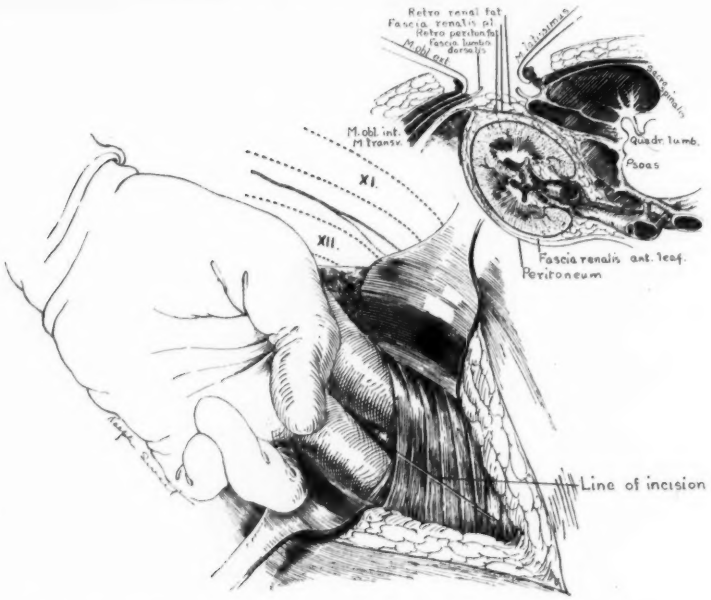

Fig. 9. Completion of the oblique-lumbar incision at its abdominal end. Peritoneum stripped from beneath the transversalis held away by two fingers and muscle cut with scissors in line of incision. Insert shows retrorenal fat layer exposed in superior lumbar trigone after the lumbo-dorsalis fascia has been slit open.

nephropexy (incision *B*, Fig. 4). The ordinary incision (*A*, Fig. 4) may be extended down the side and large tumors removed, the surgeon working more at the side than above. It is rather hard on the assistant across the table.

The abdominal route (Fig. 5) has advantages over the lumbar in certain cases, particularly of renal tumor. When performed extra-peritoneally it is just as safe. Transperitoneal exposure of the kidney carries the added risk of infection and peritonitis. With large tumors it is not always possible to expose them extraperitoneally. By a combined extraperitoneal and intraperitoneal approach, as shown by Young,[1] these large tumors may be as safely and more radically removed. This, as early advocated by Beer, Quinby and others, is the real advantage of the abdominal route. It enables better extracapsular dissection with removal of peritoneum where adherent and cleaner removal of the primary lymph zone about the renal pedicle. It permits more thorough examination of the renal vein for tumor masses, and above all the renal vessels may be ligated as the first step of the dissection, thus minimizing the danger of dissemination as the tumor is being freed as well as securing less risk of hæmorrhage. We have found the abdominal route particularly applicable to the removal of large renal tumors in children. The abdominal is also of advantage in complete uretero-nephrectomies, but for this operation most men prefer a combined double exposure, lumbar for kidney and low inguinal or outer rectus for the ureter, the whole being performed extraperitoneally. In Figure 5, the common incisions used for abdominal nephrectomy are indicated by *2* and *3;* for ureterectomy by *1* and *4*. Before our present exact methods of diagnosis were known, surgeons often elected the transperitoneal abdominal route because it permitted exploration of both kidneys through the one incision.

The abdominal and back musculature and its innervation have to be considered in both the lumbar and abdominal routes. Hernia is the exception after lumbar nephrectomy, even when marked suppuration has existed. We have had one case, successfully repaired later. But there are often persistent areas of anæsthesia and loss of muscle tonus, allowing unilateral abdominal

[1] Young. Practice of Urology. Philadelphia and London: W. B. Saunders Co., vol. ii, 1926.

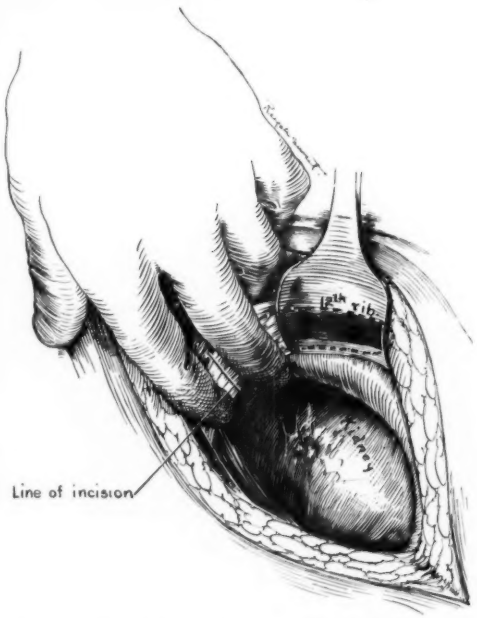

Fig. 10. *Completion of the oblique lumbar incision at its lumbar end.* The sacrospinalis and quadratus have been divided in the line of incision, twelfth rib put on tension, tips of fingers pushing diaphragm and pleura aside so that sharp edge of costovertebral ligament may be felt and cut with tip of scalpel.

relaxation which is sometimes quite noticeable. In Figure 6 the muscle layers usually cut in an oblique lumbar exposure are illustrated. In the first layer are the latissimus dorsi (Fig. 6, held up with hook), sacro-spinalis and external oblique muscles; in the second, the serratus posticus inferior and internal oblique and, in the third and deepest layer, are the transversus abdominis, and quadratus lumborum with the lumbocostal ligaments between the serratus and quadratus. The small area between the outer edges of the sacrospinalis and quadratus lumborum (Fig. 1) on the inside, the inner edges of the internal and external oblique on the outside, and the twelfth rib and edge of the serratus posticus inferior above, forms the superior lumbar trigone, the weak space in the back having only the thin latissimus dorsi as covering, and sometimes when this fails to extend down far enough, no muscle covering at all. One may expose the kidney through this triangle without dividing any muscle fibers but with surgical technique as it is today, good exposure through a wide incision is to be preferred to any method of

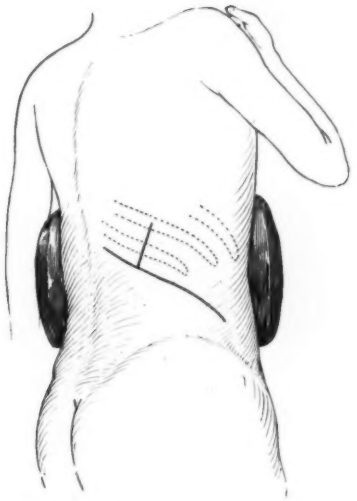

Fig. 11. The lateroposterior position of the patient with opposite arm alongside instead of folded with other in front. The "barn door" incision for rib resection is shown.

muscle preservation. The larger incisions are not mutilating.

The nerves of these muscle layers accompany the blood vessels as vein-artery-nerve from above downward. Vessels may be freely cut and ligated as none of them are terminal, but the larger nerves should be preserved, and in the lumbar route are best exposed in the superior lumbar trigone or beneath the latissimus, from which point they may be dissected in both directions. They run in the same general direction as the oblique lumbar incision (Fig. 7), which has been adopted for the express purpose of nerve preservation, and is most generally used (Fig. 8, *6*). A great many different types of incision have been advocated for lumbar exposure, some of which are illustrated in Figure 8.

The oblique lumbar incision is carried down through all muscle layers to the transversalis, as shown in Figure 7. The fibrous sheath of the lumbo-dorsalis fascia (insert of Fig. 9) at the superior lumbar trigone is split with a scalpel and its fibers spread apart by blunt finger dissection. The course of the 12th, ilio-inguinal or hypogastric nerve, any of which may be found running beneath, is next determined, and the nerve branches protected from injury. By blunt dissection with fingers, as shown in Figure 9, the peritoneum is stripped free from the inner surface of the transversalis, and its fibers are then cut with scissors in the line of the original incision. In making

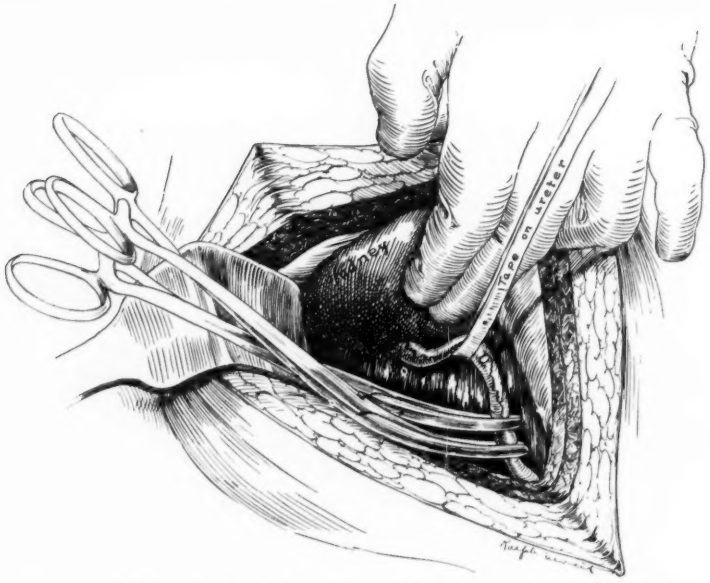

Fig. 12. Isolation and division of ureter as first step in delivery of the kidney. Usually not cut until the whole kidney is freed, but sometimes in bad infections with adherent upper pole this step gives better access.

this dissection where a long incision is desired for better exposure, the peritoneum is found somewhat more adherent the farther one gets from the kidney, and, unless care is used, is easily torn. This is not a serious matter, but the closure of holes in the peritoneum consumes valuable time and sometimes because of the position of the patient and increased intra-abdominal pressure, closure is a tedious, most aggravating procedure. With this end of the incision properly extended, one turns to the upper and usually with a normally placed kidney by far more important end so far as good exposure is concerned. The fibers of the lumbodorsal fascia are easily separated by blunt dissection to the borders of the quadratus lumborum and sacrospinalis muscles. When necessary, these may be freely divided in the line of incision, but the large subcostal vessels and nerves should be protected if possible. One now feels with his fingers deep in the angle of the incision the sharp edge of the lumbocostal ligament. Putting the twelfth rib on tension (Fig. 10), accentuates this and with the first and second fingers the diaphragm and pleura may be pushed up out of the way and the ligament divided little by little with the tip of a scalpel alongside a finger as a guide up to the insertion of the rib, enabling its retraction to a horizontal position. Never have we found it necessary to resect a rib in part or whole as practiced generally in France (Marian) nor to extend the incision as is sometimes done for such resection (Fig. 11). However, we have opened into the pleural cavity (seven times, but not all in nephrectomy), an accident it is well to avoid. Empyema developed following one such accident in a little girl who fully recovered. Aside from a few days slight respiratory distress, none of the others had any trouble. With the incision completed, towels are placed at its edges with skin clips and one proceeds to free the kidney.

TECHNIQUE OF REMOVAL

Extracapsular enucleation is the method of choice when there is no extensive inflammation, infiltration, and adhesions to the peritoneum and neighboring organs. The kidney lies above a double fat layer. The outermost, retroperitoneal or perirenal fat has been exposed by the previous opening of the fibers of the lumbodorsalis fascia and fascia quadratus lumborum (Fig. 9, insert). Beneath this is the posterior leaf of the fascia renalis which is opened by puncturing with the tip of a clamp, the blades of which are then separated. The characteristically pale, lemon-yellow colored fat protrudes,

Fig. 13. Division of the pedicle before the ureter giving freer dissection of the ureter, especially applicable in renal tuberculosis. Note position of clamps on pedicle.

proof that the puncture is made over the kidney. By gentle traction on the fibrous framework of the perirenal fat with clamps for traction added as the delivery progresses and an assistant's hand pushed under the ribs against the abdomen in front to force the kidney up, it may often be easily delivered without much dissection. At times the fibrous framework between the renal capsule and the prerenal fascia is so well developed that vigorous blunt finger dissection is required to separate them. The ease of delivery will vary. Some kidneys come out best when the lower pole and ureter are isolated and freed first. Then gentle traction on the ureter assists one in freeing the upper pole, others deliver easily by freeing the upper pole first and, by seizing it in the fingers on a sponge traction can be applied while the fingers of the other hand free the lower pole. By blunt finger dissection, aberrant blood vessels can be located from their pulsation and if necessary ligated and divided. After this, delivery is often easy where before it was incomplete. In renal and perirenal infections, the dissection is somewhat safer and easier if made posteriorly first. The fingers are guided by the back muscles and ribs as a line of cleavage. Once the back of the kidney is freed, one can follow the line of dissection around each pole with less danger of tearing into the peritoneum or

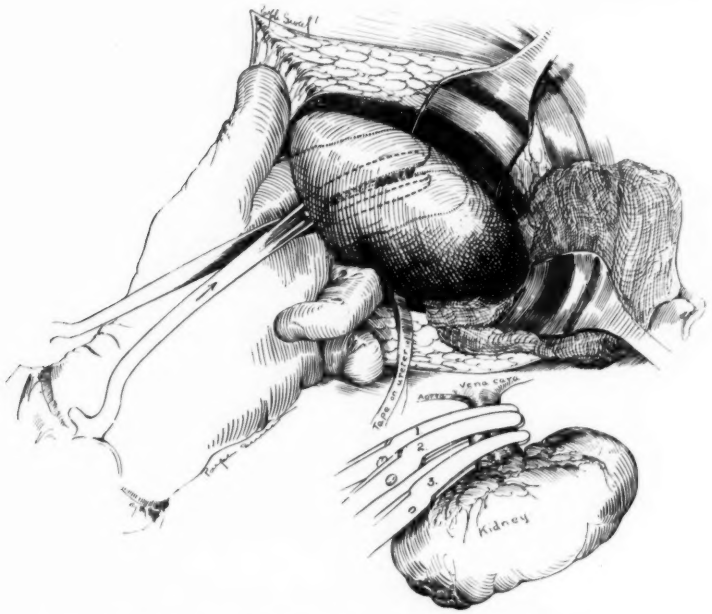

Fig. 14. Method of clamping the pedicle. The open clamp is slipped down along the fingers clasping the pedicle between them and pushing back peritoneum on neighboring organ so that they will not be caught when the blades are closed.

neighboring organs. The ureter and renal pedicle (artery and veins) are isolated and the former held up by tape traction. It is very rare indeed that the adrenal causes any difficulty. Sometimes infection extends to it. In one of our cases the postoperative course indicated the possibility of an adrenal hæmorrhage but of this we had no proof.

In *removing the kidney*, the choice of dividing first the ureter or the pedicle is governed by the individual situation of accessibility. In pyonephrosis with large thickened pelvis and ureter, division of the ureter often gives better access to the pedicle (Fig. 12). In tuberculosis, division of the pedicle gives freer access to a greater resection of the ureter (Fig. 13).

Method of pedicle ligation. The writer uses altogether the clamp method of ligation. Isolation of artery and veins and their separate ligation without clamps takes more time and in the writer's opinion carries more risk of hæmorrhage than *en masse* ligation on clamps. He has been the guest of other men at the time of both accidents; a clamp slipped off the pedicle in two instances and a ligature slipped off the artery after separate ligation without clamps in another. The hæmorrhage that results is appalling. The bleeding vessel is quickly grasped in the fingers of a hand but safe placement of a clamp on it is extremely difficult. It is just such instances that have caused the majority of duodenal and pancreatic injuries at the time of nephrectomy. In 200 nephrectomies we have never had a clamp slip nor have we had hæmorrhage from the pedicle either at the time nor after operation. We believe that this is due to the kind of clamp used, a heavy curved Ferguson clamp with male and female blades which lock so that they cannot slip. Another reason is that we always place two of these clamps on the proximal end before cutting (Fig. 13) and tie the pedicle with two No. 2 chromic gut sutures below each as it is withdrawn, the lower one being tied and removed first (Fig. 13). In placing the clamps on the pedicle it is extremely helpful if one guides the open clamp blades by the first and second fingers, which pinch the pedicle between them and push aside the peritoneum or neighboring organs from the clamp end (Fig. 14). This is important for two reasons: it makes certain an ability later to catch the suture below the clamp so that it does not engage the clamp when being tied, which is not

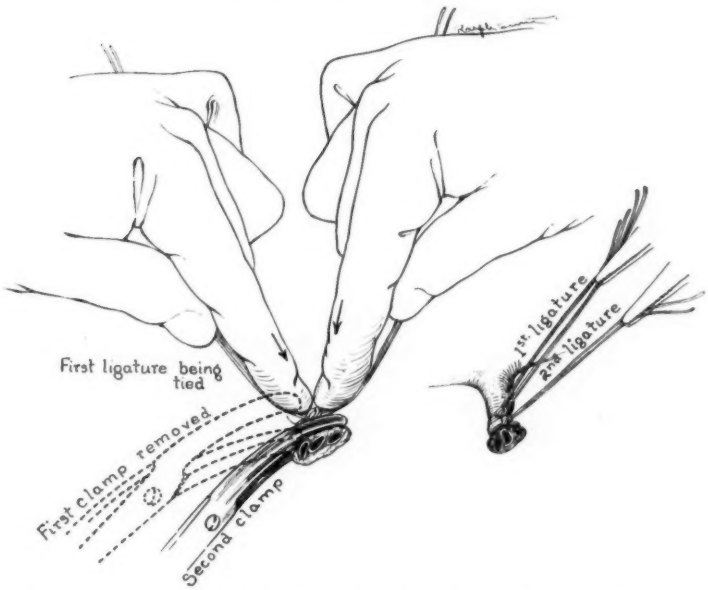

Fig. 15. Method of tying double No. 2 chromic gut ligature below the first clamp.

always possible if the end of the clamp does not project with a free margin beyond the pedicle, and it protects neighboring structures from injury by being bitten in the clamp end. We often use a double No. 2 chromic for the first suture (Fig. 15), in order that it may be tied as tightly as possible without likelihood of breaking. The second suture is single. When clamps have not been properly placed, successful ligature may be quite difficult. In only one case have we left clamps on the pedicle without ligature. This was a hurried nephrectomy in a patient of poor condition. The clamps were loosened 48 hours later and then withdrawn after 12 hours. There was no bleeding and the patient recovered. But this method is one of necessity or emergency only and is not safe.

Method of ureteral ligation. Ordinarily the ureter is doubly clamped as far from the kidney as convenient, severed with a scalpel and the distal end tied with a single chromic gut suture. In infected cases, we paint the severed ends of the ureter with pure carbolic acid followed by alcohol before suturing. In tuberculosis we sometimes inject the ureteral lumen with carbolic acid by hypodermic puncture before clamping. In some cases the ureter has been severed between clamps with the actual cautery or diathermy knife.

Intracapsular enucleation of the kidney is often preferable in advanced calculous pyonephrosis to extracapsular. Secure clamping of the pedicle in these cases is usually more difficult. The thickened distended pelvis is often adherent and free dissection sometimes dangerous. Catching a part of the pelvis in the clamps rarely occurs, and a

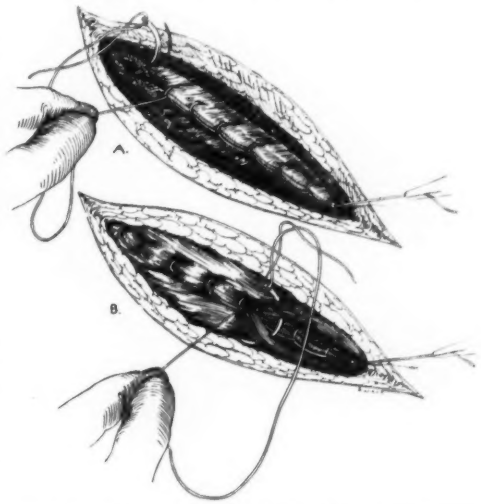

Fig. 16. Method of closing the incision by continuous interlocking chromic gut suture.

piece may be left attached to the pedicle but we have seen no bad effects follow nor have lumbar fistulæ failed to close in the average time. Slitting this thickened capsule posteriorly down to the pedicle is devoid of danger and is often a help in freeing it from the pelvis and perirenal tissues in these cases.

Drainage and closure. Rubber tube drainage is the rule after most nephrectomies. When reasonably sure that there is no infection in the pericapsular tissues as in simple hydronephrosis, early tuberculosis or tumor, the wound may be closed tightly without drainage. Bleeding from perirenal sources, muscles, etc., should be checked before closure, as a large clot may form in the renal fossa and cause trouble.

Before an attempt is made to close the incision, the pad is removed from beneath the patient or the mechanical horse lowered. Those operating tables which break in the middle, so that the head and feet ends can be raised, materially help in closing the oblique lumbar incision in the lateral position. Otherwise, in large individuals it may be hard to get the muscle ends together. Raising the shoulders and feet a little enables easy closure without traction. Usually closure is effected in two layers with continuous chromic gut No. 2 by an interlocking stitch (Fig. 16), care being used that the fascial layers are in good apposition. In long incisions or badly infected wounds, reinforcement with interrupted silkworm gut is advisable.

FROM THE CLINIC OF THE CITY HOSPITAL OF THE HAGUE

OPERATIVE TREATMENT OF OBSTRUCTION DUE TO A GROWTH IN THE DESCENDING COLON

By JAN SCHOEMAKER, M.D., F.A.C.S., The Hague, Holland

FIRST STAGE

THE first stage of the operation for the relief of obstruction due to a growth in the descending colon, is exploratory laparotomy in the linea alba with cæcostomy.

The skin of the abdomen is washed with a 60 per cent alcohol solution and painted with a 3 per cent solution of iodine. Local anæsthesia of the linea alba and of the ileocæcal area is induced with a 0.2 per cent solution of tutocaine (Bayer) and 1:100,000 adrenalin.

The incision is made 10 minutes after the injection is completed. The two ends of the proposed incision are marked by subcutaneous wheals, made with a very fine needle (Fig. 1, *A* and *B*). From these two points the entire area is infiltrated, only the two punctures being necessary. We use a 10 cubic centimeter syringe with a long needle and infiltrate the subcutaneous tissues by inserting the needle to a depth of 3 centimeters, partially withdrawing it, and reinserting it until the entire area on both sides of the median line has become infiltrated. After that we introduce the needle into the aponeurosis of the linea alba, infiltrate it with the solution, and then insert the needle more deeply so that it lies between the aponeurosis and the peritoneum. This point is easily determined, because we feel that the needle point has passed a plane of greater resistance. Here 20 to 30 cubic centimeters are injected, the needle being pushed forward, parallel to the abdominal wall, only in the median line. The solution infiltrates both sides and anæsthetizes the peritoneum.

As a laparotomy sheet is to be fixed to the skin, four subcutaneous wheals are made as indicated in Figure 1.

We now go on with the anæsthetization of the ileocæcal region. The best method is a combination of nerve blocking and skin infiltration in a square around the line of the incision.

For the nerve blocking, two points are fixed—the first one near the anterior superior iliac spine, the second just above the first, near the twelfth rib. Between these two points, the whole abdominal wall is infiltrated, so that the eleventh and twelfth intercostal nerves, the lumbar nerve, and ilio-inguinal nerve become blocked. Now we introduce the needle just under the skin and inject along the area indicated by the dotted line in Figure 2. By the time this has been done, the area first injected has become analgesic.

The incision is made in the median line from about 5 centimeters above to the same distance below the umbilicus, through the skin and subcutaneous fat. All bleeding vessels are picked up with artery forceps and ligated with catgut. After the aponeurosis has been incised, a very small incision of the peritoneum is made with a scalpel. This is enlarged at both ends with a pair of scissors, the intestines being protected by a finger introduced into the peritoneal cavity.

Inspection of the intestines. The transverse colon can be seen at the upper side of the wound; it is distended. The cotton glove of the right hand is taken off. A few drops of alcohol mixed with soap will make the rubber glove slippery. The right hand, held in the obstetrical manner, is introduced and pushed forward in the direction of the promontory. Here we are sure to find the pelvic rectum. It is narrowed. In the sigmoid we find here and there small tumors that prove to be fæcal masses. The descending colon, in which a distinct hardness is to be felt, is found fixed to the parietal peritoneum. The hardness felt is the sharp border between the distended colon above and the narrowed gut below. No metastases are to be found in the mesocolon, peritoneum, or omentum. Next, the hand slips to the liver, but nothing abnormal is to be found.

The abdominal wound is closed with linen thread, continuous catgut sutures being used in the peritoneum, interrupted stitches in the aponeurosis, and continuous linen sutures in the skin. The skin sutures are put in with a straight needle. A thimble is worn on the middle finger. The wound is painted with mastisol and covered with sterile gauze.

An incision about 6 centimeters long, parallel to the rectus muscle, is made into the second area anæsthetized. The broad abdominal muscles are cut (with no division of the fibers); otherwise these afterward would obstruct the colostomy opening.

The peritoneal cavity is opened. Distended loops of small intestine are pushed inward. An

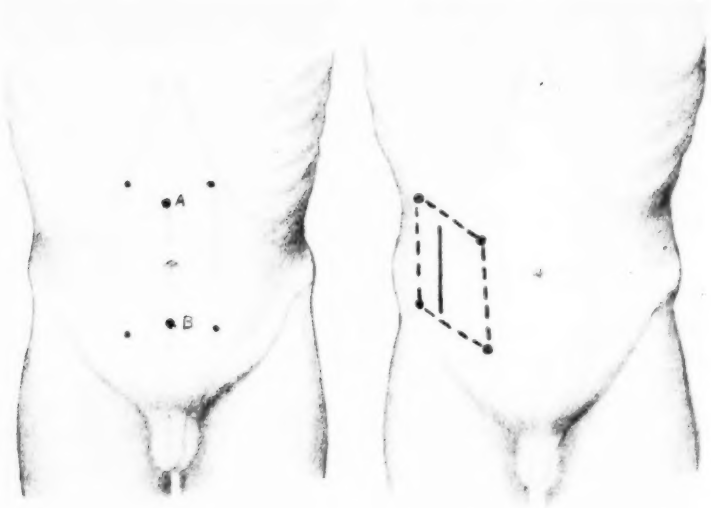

Fig. 1 (left). Dots *A* and *B* indicate line of incision. The four outer dots indicate position of subcutaneous wheals for anæsthetizing site of forceps to hold laparotomy sheet.

Fig. 2. The dotted lines indicate the line of injection under the skin.

epiploic appendix is removed and a part of the ascending colon is drawn outside of the abdomen. Eight interrupted stitches of fine silk fix the parietal peritoneum to the gut. A second row attaches the muscles, a third one the subcutaneous fat to the intestine. The wound at both sides of the fixed intestine is closed by a few interrupted stitches of catgut. The colon is punctured with a knife, and at the same instant the tube of a sucking apparatus, previously brought into position, is put against the opening. The liquid contents are removed into a receptacle. Then the opening is enlarged and the tube introduced into the intestine.

When we can be sure that the first flow is safely in the receptacle, instead of moistening the field of operation, we put a bandage of gauze and cellulose on the colostomy. The patient is put on a cot and carried to the ward.

Ten days later the patient gets full diet with no potatoes, bread, milk, or rice. Laxatives are given. For 2 days he gets only beef tea and sugar water. After another 2 days the second operation is performed.

SECOND STAGE

One hour before the operation, an injection of 10 milligrams of morphine with half a milligram of atropine is given. Ethyl chloride ether narcosis is induced. The colostomy opening is provisionally closed by an impermeable dressing fixed to the skin by means of mastisol.

After disinfection of the skin, an incision is made parallel to the outer margin of the left rectus muscle. The aponeurosis of the external oblique is divided in the direction of its fibers. The internal and transverse muscles are cut in their fleshy part so that it will be easier to suture them without endangering the inferior epigastric vessels.

After the incision of the peritoneum is made, the opening is enlarged with scissors. Collin's self-retaining retractor is introduced and opened to give a better view of the left abdomen. The growth in the descending colon is now visible and is taken by the assistant and pulled inward (Fig. 3).

An incision is made 2 centimeters to the side of the colon through all the adhesions and the parietal peritoneum; thereby we reach the retroperitoneal space behind the colon and cut with the scissors in both directions, upward and downward. The colon, now movable, is taken out of the abdomen by an assistant. The only fixation of the colon now is the transparent posterior layer of the mesocolon. By turning this to the light, we are

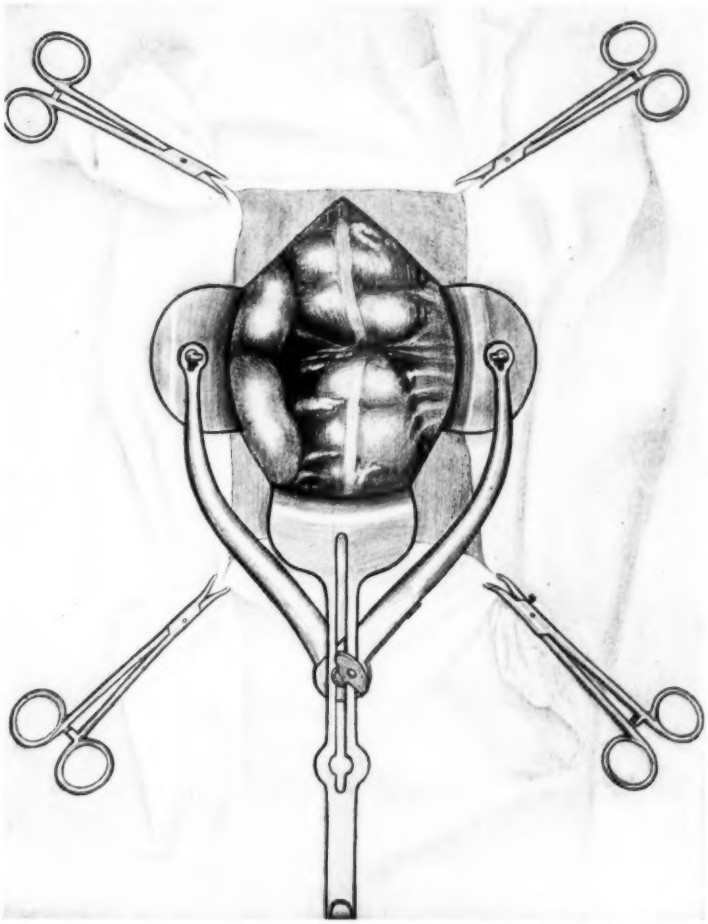

Fig. 3. Collin's self-retaining retractor in position and opened, permitting better view of left abdomen.

able to see the position and course of the mesocolic vessels.

Now we cut the mesocolon upward in the direction of the point at which the colon must be dissected, and ligate the vessels near the intestine. When all around it is dissected free, a circular incision is made in the outer layer, the serosa. This is more easy than we might think, for we scratch with the point of a knife along the surface of the colon and push the tissue to both sides. In this way we produce a 5 centimeter sleeve of mucosa plus submucosa. At this sleeve a small clamp is placed, not in the middle, but at the distal portion so that the mucosa is to be seen only at the proximal side of the instrument (Fig. 4). This clamp cannot be Kocher artery forceps, for they would probably slip after the colon is divided. The clamp must have a deep groove on the inner side; in cross section it should appear as in Fig. 4A. The tissue remaining in the hollow part prevents the instrument from slipping. When this tissue consists not only of mucosa but also of other layers of the gut compressed between the instrument, the chance that it will not slip is greater. The theoretical objection that a strip of muscularis mucosæ is brought into the intestinal lumen is of no moment; for tissue between the clamp blades must necrose and will afterward disappear.

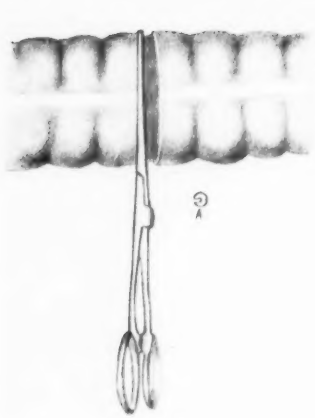

Fig. 4.

Fig. 4. A small clamp is placed at the distal portion so that the mucosa is seen only at the proximal side of the instrument. *A*, Cross section of the clamp showing the deep groove on inner side.

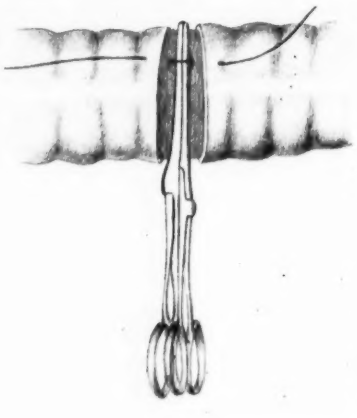

Fig. 5.

Fig. 5. The clamps are brought together and the suture begun.

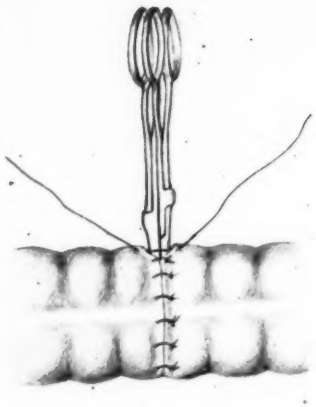

Fig. 6.

Fig. 6. The colon has been turned on its axis and the posterior wall sutured.

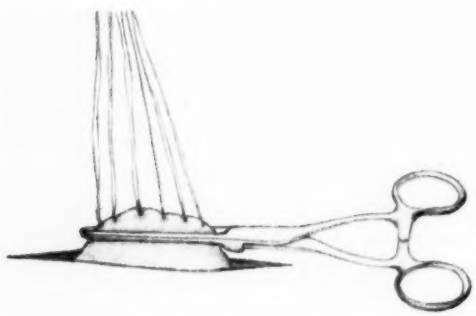

Fig. 7. The colon clamp is put on the cæcum just below the provisional suture.

Parallel to this clamp a second one is applied so close that a knife blade can just pass between the two. Then the colon is cut. Next the mesocolic vessels are ligated up to the point distal to the growth where the colon will be dissected. Here the same procedure is followed as that already described. The utmost care is taken that the clamp which will close the gut is directed to the same side as the clamp applied first. The best way is to have the points of both instruments directed to the side of the mesocolon. The clamps are now brought together and the suture shown in Figure 5 can be made. We begin at the front and the knots are immediately tied. We take care that the point of the clamps are covered with intestinal tissue, and we now proceed up to the point that is near to the lock of the instrument, without putting too much tension on it.

Now the colon is turned on its axis so that the handles of the forceps are turned upward. Thus the posterior wall is in front and the suture can be easily performed. The clamp is now removed. If this should be done without proper precautions, the contents of the colon would escape and the possibility of an aseptic suture would be absolutely destroyed. To avoid this, a stitch is carried halfway around the forceps (Fig. 6); and as the assistant loosens one pair of forceps, the knot is drawn and tied by the operator. The same is done when the second pair of forceps are removed, and the whole intestine is closed. With a straight needle the second row, a continuous serous suture, is made. This begins at the mesocolon, continues all around above the first row, and returns to the starting point.

The beginning and the end of the silk thread are tied together, and the opening in the mesocolon is closed by interrupted stitches. The colon is now brought back into the abdomen; but on the lateral wall of the colon in the parietal peritoneum is a wound made by incision at the very beginning of the operation. The edge of this parietal wound is fixed by a few silk stitches to the back of the colon near the mesocolon. Then the abdomen is closed with continuous catgut sutures through the peritoneum, the transverse muscle, and the internal oblique muscle. Interrupted linen sutures

close the external oblique muscle. No drainage is provided. Continuous sutures close the skin. The wound is painted with mastisol and covered with sterile gauze.

The patient is placed on his bed and transferred to the ward. Immediately a proctoclysis is begun with 5 per cent solution of glucose at a rate of 20 drops per minute.

A fortnight later the cæcostomy is closed, the bowels being emptied in the same way as mentioned before.

THIRD STAGE

After general anæsthesia has been induced, an incision is made at the margin of the mucosa of the intestine, through the skin and the subcutaneous fat. Interrupted stitches are made, the cutaneous margin being turned inside. The cæcostomy wound is closed provisionally. The instruments used during this stage of the operation are taken away, the cotton gloves removed, rubber gloves washed in an antiseptic, and new cotton gloves put on again. The threads of the stitches are not cut but are pulled upward with artery forceps. Then the subcutaneous fat around the cæcum is incised, the adhesions between the cæcum and abdominal wall are cut, and the peritoneal cavity is opened. The cæcum can now be made easily movable. After the adhesions have been cut with a pair of scissors, the cæcum can be lifted out of the abdomen. The colon clamp is put on the cæcum just below the provisional suture (Fig. 7), and the part of the intestine that remains outside the forceps is cut away. The opening in the cæcum is now closed with a clamp. This clamp is substituted by a suture. This suture, a continuous one, is applied directly under the clamp, a straight needle carrying the thread from the right to the left and from the left to the right. When this suture is finished, the clamp is removed, and a continuous silk serous suture closes the intestine. The abdomen is closed in the usual way.

A STANDARD TECHNIQUE FOR OPERATIONS ON PERIPHERAL NERVES

With Especial Reference to the Closure of Large Gaps

By W. WAYNE BABCOCK, M.D., F.A.C.S., Philadelphia

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THE great war opened and closed without unanimity of opinion as to many details of the surgery of peripheral nerves. Much experimental work has since been done to establish facts that could have been more accurately established by the thousands of observations made during the war. The exact value and indications for neurolysis, neurorrhaphy and hersage remain to be defined. Experimental evidence has continued to accumulate showing the efficiency of nerve grafting in animals[1], together with reports from clinics showing how useless the nerve grafts usually are in human practice. The remarkable tolerance of nerve trunks to trauma and infection is not generally appreciated. Unnecessary and even harmful nerve flaps or inlays continue to be used or resection of long bones performed, when end-to-end suture would be entirely feasible, would the operator but use the full resources of the art. Since evidence of sensory and motor regeneration is so often mimicked by the substitution activities of adjacent nerves and muscles, examinations made by those untrained in the field of neurology are unworthy of consideration. But even with this fact established, reports continue to be based on written opinions from patients themselves. Our textbooks on surgery continue with illustrations and descriptions of old and useless operations on nerves. If we are to benefit by the enormous experience in neurosurgery of the War, it is time that observations were correlated and that standardized methods were formulated and adopted.

If fine silk is the best material for nerve suture, why do we continue to use catgut? If sutures limited to the nerve sheath do the least harm, why follow the transfixion suture method of Gosset? If causalgia usually subsides when the lesion is corrected, why continue to ignore the lesion and to damage the nerve further by injecting alcohol or other chemical? If end-to-end suture is possible, why continue unnecessary and useless nerve grafts? If regeneration is the normal procedure after nerve suture, why not re-explore in any case in which, after a reasonable time, there is no evidence of regeneration? If a 15 centimeter gap in the median or musculospiral nerve can be closed with end-to-end suture, why do we continue to substitute less effective or more mutilative procedures for a gap of only 8 to 12 centimeters?

The following suggestions toward a standard technique are based largely on a technical evolution personally drawn from 660 cases of nerve injury.

[1] A nerve graft 3 centimeters long in the experimental animal should not be compared with a graft 8 to 12 centimeters long used in human practice. For the short distance neuraxes may bridge the gap without even penetrating the graft, for the long graft an obstructive fibrosis develops in the lower end of the graft, serving as does a scar or neuroma to block the downward penetration of the axis cylinders.

TYPES OF OPERATION

Four types of operation only need be considered: exploration, neurolysis, hersage, and neurorrhaphy.

Exploration is the most important step of any operation upon an injured nerve, for upon its findings the character of the needed treatment is determined. Failure to explore the nerve trunk properly, has been responsible not only for failures in operative treatment, but has produced serious sources of error in the conclusions and statistics of various operators. For example, careful exploration has revealed a definite mechanical obstruction in every one of our cases in which no evidence of regeneration followed the suture of a divided nerve. In our experience, causalgia also means a definite, uncorrected, and therefore, usually an unrecognized lesion of a nerve, and it is much more logical to demonstrate and to eradicate the lesion than to use blunt conductivity and stimulate fibrosis in a nerve trunk by injecting alcohol. The exploration, to be complete, must freely isolate the nerve in all its areas of possible injury, prove that it is the nerve sought, and especially that its component bundles are not subject to interruption or compression. The exposure should be free, and if there is any doubt as to the nature of the exposed cord, it should be traced to some unmistakable land mark. All points of possible compression and abnormal adhesion should be relieved and the nerve sheath, if thickened or abnormal in appearance, freely split in the long axis of the

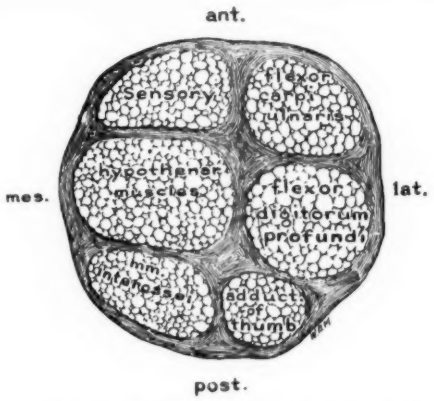


Fig. 1. Arrangement of nerve bundles in the ulnar nerve just below the elbow (diagrammatic). By a knowledge of the nerve pattern, an accurate diagnosis of a partial nerve injury may at times be made.

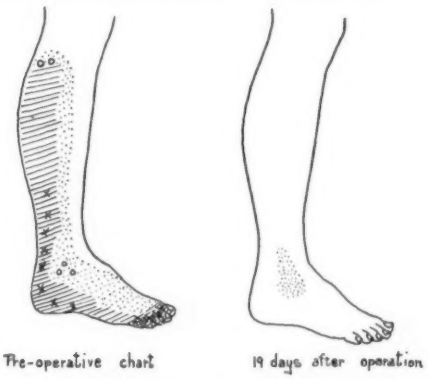


Fig. 2. Paradoxical almost immediate return of sensation after suture of a divided peroneal nerve. The anomalous return of sensation was due to liberation of the undivided but compressed musculocutaneous branch. From experience like this the operator may erroneously conclude that regeneration after suture of a divided nerve is possibly within a few days or weeks. Dots indicate loss of tactile sensation; cross lines, the pain sensation; crosses, the loss of muscle sense.

nerve. Finally, and of especial importance, the integrity of the contained nerve bundles should be demonstrated. With a thin, nonadherent nerve sheath, careful inspection and palpation is often sufficient. However, when the nerve is adherent, the sheath thickened, and evidence of the condition of the normal bundles obscured, the sheath should be opened freely and the nerve bundles exposed sufficiently to prove their condition. At times, this necessitates a thorough hersage of the entire thickness of the nerve for a distance of 5, 10 or more centimeters. In any case the breadth, thickness, and length of any fibrous or degenerated area within the nerve should be fully explored by sufficient longitudinal incisions in different planes. The amount of intraneural exploration should be based on the extent of the damage found, the technique used being similar to that described for hersage. Not infrequently, lateral, central, or total areas of fibrosis are shown by this exploration which were not clearly evident before the nerve trunk was incised. It is surprising that skilled operators have ignored the importance of intraneural exploration. Because a cord has the diameter and contour of a normal nerve trunk, does not prove that it is a normal nerve. The operator, when clinical examination has shown definite evidence of interruption following injury, has not done his part until he has demonstrated as fully as surgical art will safely permit the integrity of the nerve, both within and without the nerve sheath. To those who contend that the method is too severe, we would invite attention to the relatively slight clinical evidence of damage following, through neurolysis and hersage[1], and to the results obtained in cases where operation without intraneural exploration had or would have failed to give relief.

Electrical Tests. Very interesting are conduction tests made with a very fine bipolar electrode and the induced current on the exposed and opened nerve trunk. We have used these tests to determine the possibility of conduction through a damaged area in a nerve trunk, to work out the nerve pattern or the situation and function of the individual nerve bundles, and to locate cor-

[1]Spear, and Babcock. Peripheral nerve injuries, Arch. Neurol. & Psych., 1919, Sept.

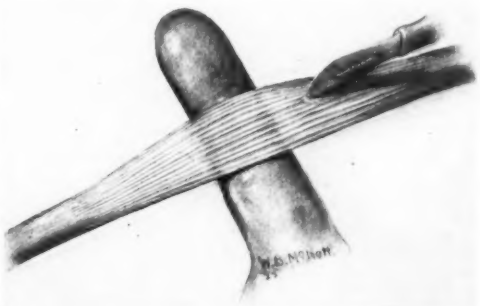


Fig. 3. Hersage, a nerve fiber disassociation. With a fine, very sharp knife the nerve trunk is converted in the area of fibrosis to a flat ribbon of separated fibers.

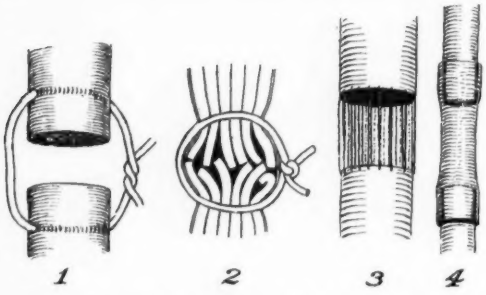


Fig. 4. Illustrating faulty methods of nerve suture. *1*, Undesirable transfixion suture which lies in the path of regenerating axis cylinders. *2*, Undue tension from transfixion suture, displacing the nerve fibers. *3*, Suture *a distance* by silk or catgut. *4*, Use of connecting tubes of hardened blood vessel or other material, harmful by interfering with the vascular supply to the ends of the divided nerves.

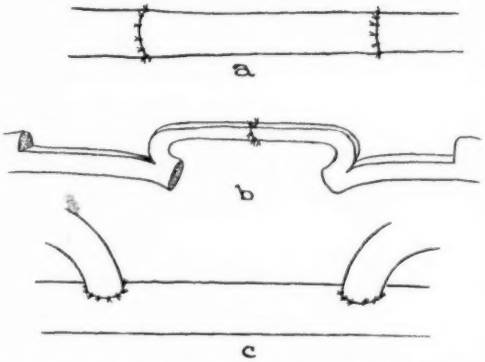


Fig. 5. Illustrating methods of neurorrhaphy formerly advocated that have been found, as a rule, to be useless. *a*. Nerve grafting; *b*, suture by nerve flap formation; *c*, nerve suture by substitution or lateral implantation into an adjacent undivided nerve. None of these methods should be used.

responding bundles above and below the injury as a guide to suture. We may briefly summarize our conclusions for chronic traumatic lesions as follows:

1. Electrical tests to determine sensory conduction have not been very successful in our experience. With the unconscious patient, or the patient under a general anæsthetic, the guide to sensory interpretation is lost. Under local anæsthesia, the tests are distressing to the patient, or if nerve blocking has been used, have an uncertain value. Under spinal anæsthesia at times the blocking of the spinal nerve roots is sufficient to prevent shock or severe pain from the tests, and yet not sufficient to prevent sensory interpretation.

2. Motor tests, made by applying the fine bipolar electrode to various parts of the exposed or opened nerve trunk and carefully noting the muscular contractions produced, have certain limitations. The nerve may be conductive, but the muscle from advanced fibrosis and atrophy may be non-contractile. The nerve fibers may not be interrupted, and yet be non-conductive as a result of pressure either within or without the nerve sheath. The electrical current may radiate from the bundle tested to adjacent bundles or muscles causing contractions that may lead to erroneous conclusions. Not infrequently the same muscle or muscle group will respond, no mattêr to what bundle within the nerve the current is applied, so that a correlation of tests of the same nerve in many patients is necessary to determine the nerve pattern. After the division of a nerve, electrical conductivity is rapidly lost. In no case have we been able to prove electrical conduction through a nerve or nerve bundle when the continuity of the nerve bundles was not evident to the naked eye. Thus, while it might be thought that nerve fibers, invisible except by microscopic examination, would frequently be present and conduct electrical impulses through a neuroma or other fibrous area lying in the nerve trunk, in none of our observations did this occur. Nerve bundles that show no macroscopic evidence of interruption may fail to give the electrical conduction reaction, but in no case where there was macroscopic evidence of interruption was there electrical conduction. In other words, careful inspection of an injured nerve gives much more reliable information as to the degree of injury, the prognosis and the treatment, than electrical tests. In determining the topography of an undivided, or very recently divided nerve, or the function of a branch or bundle, the electrical tests have value. To indicate the regeneration of the nerve, the electrical tests so lag behind the sensory and voluntary motor return that stimulation of the exposed nerve rarely will reveal more function than the patient can demonstrate voluntarily in the pre-operative examinations.

Neurolysis. The simplest operation for the interruption of conductivity in a nerve is that to relieve compression from without. The nerve may have been strangulated in scar tissue or compressed through fibrosis, callus, bone fragments, or foreign bodies. In one of our cases a Lane plate had been screwed to the humerus over the musculospiral nerve. As a rule, access to a nerve is obtained by freely excising the old scar. The

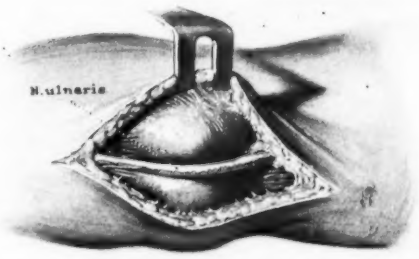


Fig. 6. Illustrating the normal elasticity of peripheral nerves. The intrinsic blood vessels where nerves pass around joints are tortuous, permitting elongation when the joint is flexed. Ulnar nerve behind internal condyle showing normal tortuous vessels.

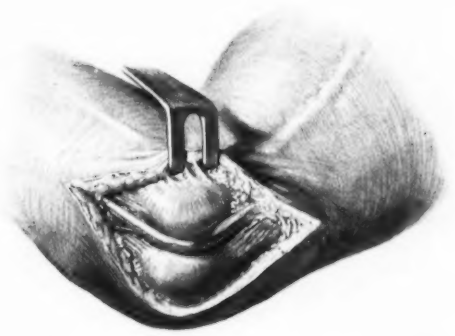


Fig. 7. The ulnar nerve on flexion of elbow showing how the vessels of the sheath lose tortuosity from the normal stretching of the nerve.

nerve is first exposed both above and below the point of injury, is carefully freed through the area of compression, injury to the nerve trunk or important branches being avoided, placed in a soft vascular bed, and the wound sutured. In these cases we make it a rule to split the nerve sheath to relieve tension, and to be sure that the contained bundles are uninterrupted, so that a slight hersage has usually accompanied the neurolysis. The nerve is carefully isolated from adjacent bone by interposing muscle or by burying the nerve trunk in a muscle or in an intermuscular plane. No drainage of the wound is required. Causalgia often is at once relieved by the operation, and the patient may notice an improvement in sensation several days after operation. What seemed like a paradoxical, almost complete return of sensation 3 days after suture of the peroneal nerve in one of our cases, was due to the associated neurolysis of the musculocutaneous branch which had escaped division.

Neurolysis may be required after nerve suture to relieve compression that is preventing regeneration. In two of our cases it was found that forming callus led to compression of the nerve after suture. In a third patient, evidence of regeneration rapidly followed after we removed sutures and divided the fibrous sheath at the point of a former nerve suture. From this simple operation of neurolysis 80 per cent of our patients improved within a few months. Thirty-three per cent were markedly improved in from 4 to 8 weeks, and some had a complete restoration of function as early as the fifth week.

Hersage, combing or the disassociation of the fibers of peripheral nerves. Hersage was advocated in 1907.[1] It is employed when conduction is interrupted by conditions within the nerve sheath not sufficiently severe to require excision of the diseased segment with end-to-end suture. Compression from thickening of the nerve sheath, intraneural exudate, limited fibrosis and certain neuromata in continuity are thus treated. The term has been applied to a variety of operations ranging in extent from the splitting of the sheath with one or two slight incisions in the nerve, to a thorough disassociation of fibers throughout the area of disease by which the rounded nerve is transformed into a ribbon of very fine free fibers in continuity with the nerve trunk. We have followed our original technique.[2] "The neurolysis is intended to permit the escape of exudate from within the nerve sheath, to reduce pressure upon individual nerve fibers, to free axis cylinders which have become useless through entanglement in scar tissue, to facilitate the formation of new, or the restoration of old nerve paths, and to stimulate desirable trophic changes in the nerve trunk. A free longitudinal incision of the nerve sheath is made. The sheath should be divided, if possible, well beyond the limits of the lesion. The nerve trunk is then lifted upon one or two fingers or suitable blunt hook, held taut, and the nerve fibers carefully separated from each other by means of a small, sharp tenotome. Care is taken to divide as few nerve fibers as possible, although it is aimed to separate freely the nerve bundles from each other. As the operation proceeds, the nerve is transformed from a rounded cord to a flat ribbon-like band of separated fibers. If cicatricial tissue is encountered in the nerve trunk, the separation of the fibers is prolonged along straight lines, dividing the scar into multiple parallel threads of tissue. During the operation

[1] Babcock. Nerve, 1907.

[2] Disassociation. Ann. Surg., 1907, xlvi, 686.

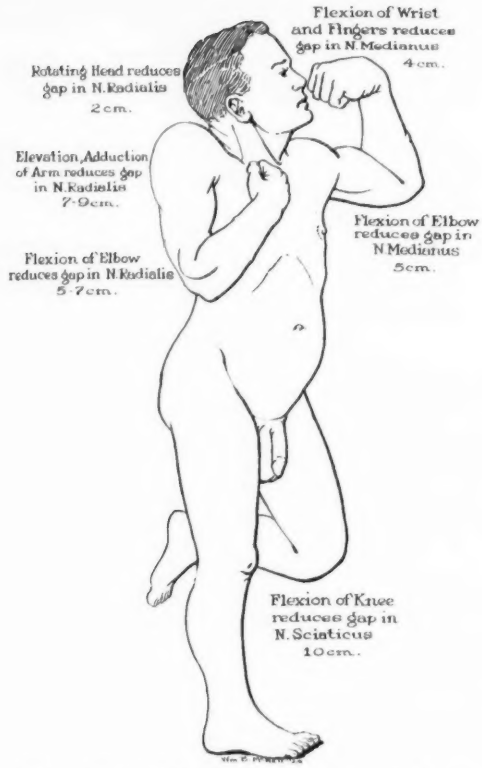

Flexion of Wrist and Fingers reduces gap in N. Medianus 4 cm.
Rotating Head reduces gap in N. Radialis 2 cm.
Elevation, Adduction of Arm reduces gap in N. Radialis 7-9 cm.
Flexion of Elbow reduces gap in N. Medianus 5 cm.
Flexion of Elbow reduces gap in N. Radialis 5-7 cm.
Flexion of Knee reduces gap in N. Sciaticus 10 cm.

Fig. 8. Illustrating positions used in overcoming gaps in peripheral nerves. The length of gap that may be overcome is indicated.

it is important that the nerve be handled gently, be not subjected to strong traction, and that the knife be sufficiently sharp to separate, without unnecessarily pulling, tearing, or bruising the nerve fibers." This rather severe operation usually does not increase the previous anæsthesia or paralysis. In a small number of cases there has been a surprising restoration of function appearing within a few days after operation. While improvement often follows after the hersage of an almost total traumatic fibrosis or fibrous neuroma of a nerve, the improvement is rarely complete, and in such cases partial or complete resection of the nerve with suture is to be preferred. When evidence of regeneration does not appear within a reasonable time after nerve suture, we would strongly advocate exploration and limited hersage of the area. We no longer isolate the hersaged nerve by fat or fascia transplants, but prefer to leave it in a normal vascular bed.

Fig. 9. A gap of 4 centimeters in the median nerve may be overcome by flexion of the wrist alone.

Neurorrhaphy, or the suture of a divided nerve, should refer to but one method, namely, an accurate end-to-end suture. *Suture à distance* with catgut, silk, or other material, with or without conducting tubes of Cargile membrane, fascia, hardened arterial wall, or other substance mark the bizarre, fantastic stage in the evolution of the suture of nerves, as do also substitution sutures, nerve flap formation, and lateral implantations. These procedures should promptly be erased from our surgical textbooks.

After a nerve has been divided, no other method compares in results obtained with those from the simple end-to-end approximation of the freshened nerve ends by interrupted sutures of very fine silk in the nerve sheath. If the sutured nerve is now placed in an aseptic vascular bed, there is a strong tendency for regenerative changes to follow. An intermuscular plane is the normal and best location for a sutured nerve.

Gap. The chief technical difficulty in suturing a divided nerve lies in the distances separating the freshened nerve ends. Gaps of 8 or 10 centimeters have repeatedly led to inadvisable and often useless operations, because the surgeon was not familiar with the simple principles that enable large gaps to be overcome. Long bones have been needlessly resected and nerve grafts giving no return of function frequently inserted, when

Fig. 10. Rerouting the ulnar nerve. Illustrating the greater length of slack to be obtained by splitting the sheath of the nerve and stripping back the muscular branches. This enables the nerve to assume a more anterior position in front of the elbow. *a*, *b*, *c*, Muscu'ar branches.

end-to-end suture without undue tension was entirely feasible. We should standardize the maximum gaps in divided nerves that safely may be overcome by suture in association with the technical methods for overcoming those gaps, so that a surgeon may, on ascertaining the length of gap, instantly determine the necessary operative procedure. The gaps we have closed are much longer than those elsewhere given and have aroused the erroneous impression that the nerve must be unduly stretched or traumatized. Gaps are overcome in five ways, as follows:

1. By the normal slack and elasticity of the nerve trunk. It has not been appreciated that nerves have a well marked elasticity, stretching and contracting as joints are moved. Evidently this is greater than the elasticity of the accompanying blood vessels as shown by the marked tortuosity of vessels attached to nerve trunks in the vicinity of joints which is largely lost as normal movement puts the nerves under tension. If any of the long nerves be sufficiently freed, a gap up to 3 centimeters may, by the normal slack and elasticity, be overcome without other procedure. Nerves, however, have a limited elasticity and only short gaps are to be closed by stretching the nerve. The distance gained is, of course, directly proportionate to the length of the nerve trunk liberated, and it is important to use long incisions and have ample exposure. It is difficult to conceive of a trained surgeon so brutally stretching a nerve as to rupture its fibers or to produce secondary degeneration in the ganglionic cells. The instruments used for holding nerves should be so delicate that they will tear from the nerve before dangerous tension is exerted.

2. Flexion and extension. Flexion of the wrist alone will overcome a gap of 4 centimeters in the median or ulnar nerves; flexion of the elbow, a gap of 5 centimeters in the musculospiral or median nerves. Acute flexion of the knee will overcome a gap of 8 centimeters in the sciatic or popliteal nerves, dorsiflexion of the foot 4 centimeters, in the anterior tibial nerve; extension of the elbow adds 1 or 2 centimeters to the ulnar nerve, hyperextension of the thigh 2 centimeters to the sciatic nerve, extension and abduction of the foot 4 centimeters to the posterior tibial nerve.

3. Adduction—adduction or rotation of adjacent joints. We have found that adduction of the shoulder alone gives sufficient slack to enable one to overcome a gap of 7 centimeters in the musculospiral nerve, and somewhat shorter gaps in the other branches of the brachial plexus. Rotation of the head to the opposite side gives 1 to 2 centimeters additional slack in the cords of the brachial plexus. This may be increased by raising the shoulder on the side of operation.

4. Rerouting. By rerouting the ulnar nerve from its position behind the inner condyle of the humerus to the front of the elbow (an old well-recognized procedure) and then flexing the elbow, the distance the nerve subtends may be shortened 7 centimeters. By rerouting the median nerve from its deep position at the elbow,[1] to a superficial position and then acutely flexing the elbow, about 12 or more centimeters in slack is obtained. By unwinding the musculospiral nerve from the humerus and rerouting to the front of the humerus, the distance traversed by the nerve is shortened 3 or 4 centimeters. Rerouting is the most severe of the procedures used, and should not be employed if simpler measures will suffice. With the musculospiral nerve, the damage to the branches

[1] Babcock. Surgical notes, 1918.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 11. Operation of rerouting median nerve below the elbow to overcome a large gap. A large adherent neuroma of the ulnar nerve is shown involving the lower third of the forearm.

Fig. 12. Operation for rerouting median nerve continued. The neuroma and adjacent portions of the nerve trunk have been freed from adhesions and the neuroma grasped by forceps passed between the heads of the pronatorteres preparatory to withdrawal.

Fig. 13. Rerouting median nerve. The proximal portion of the median nerve has been withdrawn from its deep muscular position at the elbow. The upper muscular branches interfering with displacement of the nerve at the elbow joint are shown.

supplying the biceps is such that it is an undesirable operation. When rerouting a nerve, it is desirable that the sheath be slit sufficiently from points where important branches of the nerve emerge, so that the branches will strip back and leave the nerve at a higher level and will not be ruptured or interfere with the transposition of the main trunk. This is especially necessary and somewhat difficult with the median nerve which gives off a number of important muscular branches from its deep position just below the elbow. Our postoperative studies indicate that regeneration occurs, but is slower after rerouting, and also that muscular branches may be freely stripped back, so as to emerge at a higher point on the parent trunk without interference with their function.

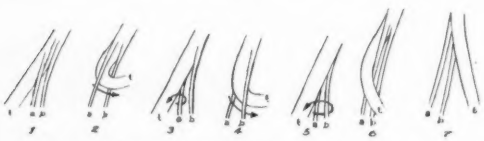


Fig. 14. Expedients used in liberating median nerves at the elbow. The sheath overlying the muscular branches *a* and *b* of the main trunk of the nerve is split and the muscular branches stripped back so that they are given off from the main trunk at a higher level. The main trunk is liberated from the restraining branches by the expedients shown in *2*, *3*, *4*, *5* and *6*. In this way the median nerve is liberated at a point well above the elbow joint and may be brought to a subcutaneous position.

5. Elongation of the nerve by a two or three stage operation. In this, at the first operation, the gap is overcome as far as is possible and the nerve ends united, under moderate tension with the nerve at its greatest relaxation, by sewing the neuromata together or by *suture à distance.* The nerve trunk is then progressively elongated by gradually extending or otherwise moving adjacent joints. When sufficiently elongated, the nerve is again

exposed, the ends freed, the gap overcome and neurorrhaphy performed. One such case occurred in our series in 1918. At the first operation a 7 centimeter gap in the median, and an 11 centimeter gap in the ulnar nerve were overcome in the arm. Several months later when the forearm had been fully extended, an added gap of 10 centimeters of the median and 5 of the ulnar were overcome with end-to-end suture. In this case the nerves had not been completely divided, but had been raked longitudinally by a bullet traveling parallel with their course and the operations enabled us to resect a total of 17 centimeters of the median and 15 centimeters of the ulnar nerve with end-to-end suture. This operation rarely is required.

Table I shows the maximum gaps found in our series. In no case was it impossible to overcome the gap, yet because a technique had not been developed, in an early case of the series, to correct a 10 centimeter defect in the median nerve, a graft was used.

Ulnar nerve. In the forearm we have found 6.5 centimeters the maximum distance between the nerve ends that may be overcome without rerouting or liberating the nerve above the elbow. This represents the sum of 4 centimeters obtained by strongly flexing the wrist, 1 centimeter by hyperextending the elbow and 1.5 centimeters from the normal slack and elasticity of the nerve. In any gap of 5 centimeters or over, the freeing of the brachial portion of the nerve or rerouting should be considered. By rerouting the nerve to a position in front of the elbow and freeing the nerve above the elbow, 6 or more additional centimeters may be obtained, enabling a gap of over 12 centimeters to be overcome.

In the upper arm 5 to 7 centimeters may be gained from the brachial plexus by adducting the arm, and 2 to 3 centimeters from the normal slack and elasticity of the nerve, with 2 centimeters from hyperextension of the elbow, making a total of 9 to 11 centimeters without resort to transposition of the nerve in front of the elbow. Six additional centimeters are obtained if the nerve is rerouted, making a total possible gain of 15 to 17 centimeters.

TABLE I.—MAXIMUM GAPS AFTER RESECTION OF NEUROMATOUS AND FIBROUS NERVE ENDS FOUND IN 610 CASES OF NERVE INJURY

Approximate maximum gaps in peripheral nerves expressed in centimeters in which end-to-end suture is possible

	By slack and elasticity cm.	By joint position cm.	By rerouting cm.	Total cm.
Brachial plexus	1.5	3.7	....	11½
Radialin arm	3	7.5	....	15
Radial in forearm	1.5	5.4	....	10½
Ulnar in arm	3	7	6	16
Ulnar in forearm	1.5	5	6	12½
Median in arm	3	5.7	....	15
Median in forearm	1.5	4.3	14½	23
Sciatic	3	3.8	....	14

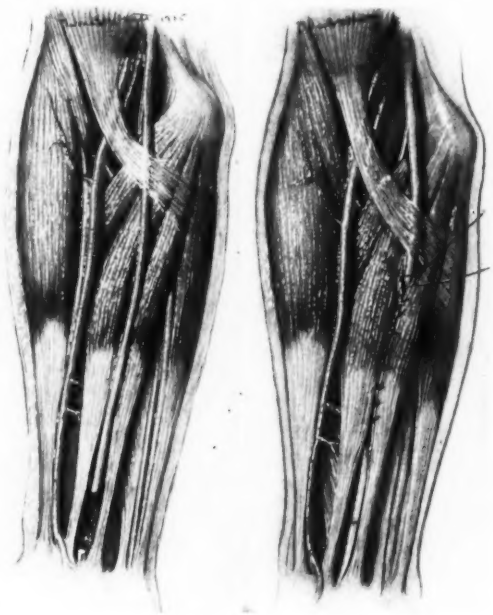


Fig. 15 (left). Rerouting the median nerve, continued. The freed proximal end of the nerve is placed anterior to the muscles of the forearm. The intrinsic blood supply of peripheral nerves permits large areas to be separated without secondary necrosis.

Fig. 16. The median nerve is given a thin muscular covering by uniting the radial edge of the palmaris longus to the ulnar edge of the flexor carpi radialis.

Median nerve. In the forearm, gaps up to 8.5 centimeters may be overcome by acutely flexing the wrist and elbow and by the normal slack and elasticity of the median nerve. In 1919,[1] by a method of rerouting, we found it possible to overcome gaps of surprising length. This operation enabled us to correct by end-to-end suture the largest gap we have met in practice, i.e., 15.5 centimeters, while in the adult cadaver we have closed a gap of over 20 centimeters; 4 centimeters by flexion at the wrist; 1.5 centimeters from the normal slack and elasticity of the nerve, and the remaining 14 centimeters by the rerouting and acute flexion of the elbow. In overcoming these large gaps in the forearm, the nerve is exposed from the hand to a point well above the elbow.

[1] Babcock. Neuro Surgical Exchange, 1919, May 1.

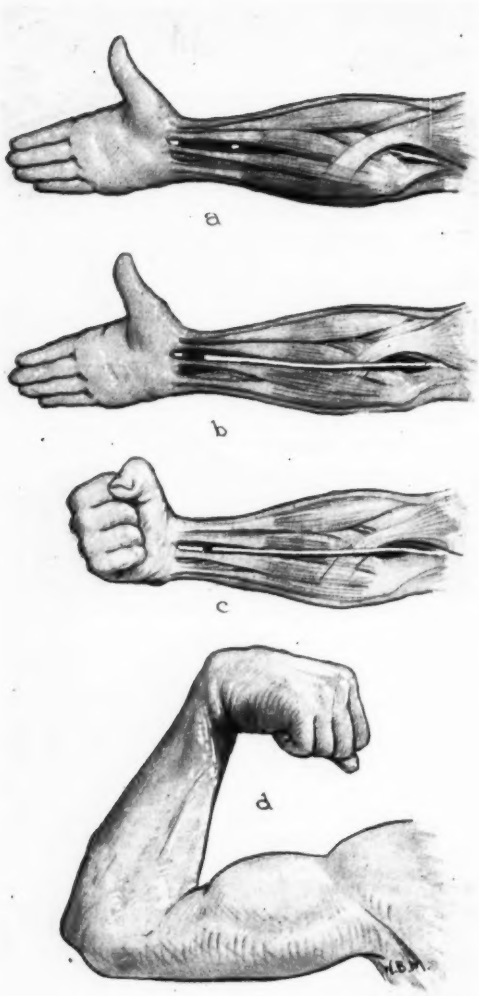


Fig. 17. Illustrating steps in the operation for rerouting median nerve showing additional slack which is gained by flexion at the wrist and elbow joints.

The proximal end is liberated and withdrawn at the elbow from beneath the deep flexor muscles of the hand and fingers through its tunnel between the heads of the pronator teres.

The muscular branches given off below the elbow to the pronator radii teres, the flexor carpi radialis and the flexor digitorum profundus are now caused to leave the main trunk at points well above the elbow by dividing the overlying sheath and carefully separating the branches from the other nerve bundles to a sufficiently high point above the elbow to avoid tension when the nerve is transplanted. The main trunk is unthreaded through the loops that are produced in this process. If carefully done the muscles supplied by these split-off fibers retain the power of voluntary contraction after the operation. The diseased ends of the nerve are now resected, laid upon the superficial muscles of the forearm, and end-to-end apposition and suture attained by acutely flexing the elbow and wrist. The edge of the palmaris longus is then united to the flexor carpi radialis over the nerve, and the skin and subcutaneous fascia carefully sutured. The operation is based on the much shorter arc subtended with the flexed elbow when the median nerve is transplanted from its normal deep, to a superficial position just below the elbow.

In the arm, as with the ulnar nerve, 5 to 7 centimeters of slack may be obtained from the brachial plexus by adducting the arm and elevating the shoulder, 2 to 3 centimeters by the normal slack and elasticity of the nerve, and 5 centimeters by flexion of the elbow joint withour rerouting, a total of 13 to 15 centimeters. Obviously, the rerouting or transplanting of the median nerve in the forearm to overcome defects above the elbow is not practical, without division of muscles or of important nerve branches.

Brachial plexus. By turning the head toward the opposite side, elevating the shoulder and carrying the arm forward in adduction, gaps up to 10 centimeters in the brachial plexus may be overcome.

Sciatic nerve. With this large nerve, we have closed a gap of 13 centimeters. Two centimeters are obtained by hyperextension of the hip, 3 centimeters from the normal slack and elasticity of the nerve, and 8 centimeters by acute flexion of the knee. By a more extensive liberation of the nerve, toward the pelvis and below the popliteal space, a slightly greater distance may be overcome.

Anterior and posterior tibial nerve. By using the slack obtained by liberating the lower portion of the sciatic and popliteal nerves and by flexing the knee, 6 centimeters may be gained for the anterior tibial, and 8 centimeters for the posterior tibial nerve, plus 1 or 2 centimeters from the normal slack and elasticity of the nerve. With the additional distance of 4 centimeters gained by dorsiflexing the foot for the anterior, or plantar flexing and adducting the foot for the posterior tibial nerve it is evident that a gap of from 13 to 15 centimeters long may be obliterated in these nerves.

Fig. 18. Illustrating method of obtaining slack in the brachial plexus. The arm is adducted, the shoulder elevated and the head turned toward the opposite side, giving a slack of 7 to 9 centimeters in the plexus of the adult.

Fig. 19. Incision for exposing the musculospiral nerve in the upper part of the arm.

Radial (musculospiral) nerve. A slack of 7 centimeters is produced in the upper end of the musculospiral nerve by carrying the arm forward close to the chest. This slack is not evident until the nerve is gently liberated from its attachments as it winds back of the humerus after leaving the brachial plexus. In the lower arm, 5 centimeters additional may be obtained by acutely flexing the elbow, and adding 2 to 3 centimeters for the normal slack and elasticity of the radial nerve in the arm, it is evident that end-to-end suture is possible with a defect of 15 centimeters. It is difficult to conceive of a defect of more than 15 centimeters in the radial nerve of the arm without destruction of the arm, and the few centimeters additional that may be gained by rerouting the nerve to the inner or anterior face of the humerus, should rarely be necessary. In one instance we rerouted the radial nerve to the inner side of the humerus before discovering the abundant slack to be obtained at the shoulder. In this case it was very difficult to transplant the nerve from the back of the humerus without damaging important muscular branches. In the forearm defects in the radial nerve and its branches up to 10.5 centimeters may be overcome by flexion at the elbow, extension of the wrist, and taking up the normal slack in the nerve.

TECHNIQUE

The overcoming of large defects in peripheral nerves for end-to-end suture is only possible when certain expedients are used. The surgeon who operates with a limited exposure is doomed to failure. Very long incisions are necessary, and if possible, they are so planned as to include the excision of old scars. An incision even from the shoulder to the wrist may be made, and after accurate closure of the skin and subcutaneous tissue leave a fine linear scar. Through the excision of the previous deforming cicatricial tissues, the liberation of adhesions, the mobilization and replacement of muscles, a marked cosmetic as well as functional improvement is usual despite the length of incision used. An exception must, of course, be made in patients with a tendency to keloid formation.

The nerve is very freely exposed well above and well below the site of injury and then followed into and liberated from adhesions and scar.

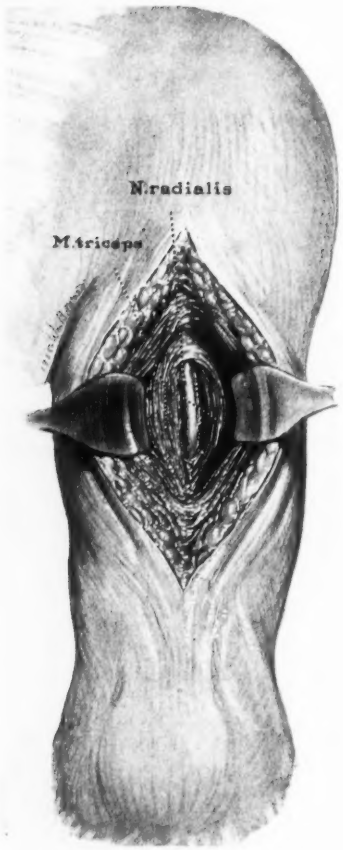


Fig. 20. Musculospiral nerve exposed between the heads of the triceps.

Having determined by exploration the amount of resection of the nerve ends necessary to obtain well formed fasciculi, the gap that will remain is measured and the expedients necessary to enable end-to-end union computed. To take advantage of the normal slack, elasticity, and the relaxation produced by joint movement, the nerve must carefully be released from its adjacent attachments. If the nerve passes through or under important muscles, these are not divided, but the nerve is mobilized by smooth round-ended scissors or hæmostatic forceps, which are passed along the nerve and gently opened, until the nerve may be slid in the canal as careful traction is made on it. To obtain the full effect of flexion or other position at joints, it may be desirable to place the nerve in a more superficial position, and to divide partially an overlying annular or other restraining ligament. If the movement of the nerve is restricted by important branches, these should be mobilized as previously described. Patience, gentleness, ample exposure, and accurate anatomical knowledge are most important.

I would make it a rule, to which there are rare exceptions: "If the gap in an important peripheral nerve cannot be overcome without nerve grafting or resection of bone, then the part will be found so disorganized that a nerve suture will be useless and unnecessary." As a corollary "A graft or bone resection to enable nerve suture usually indicates that the operator has failed to use the full resources of his art."

With a bony ankylosis, a fracture involving the joint, or an arthritis, end-to-end suture may be impossible without involving the associated lesion. A loss of nerve function may be preferable in rare cases to a disturbance of the bone or joint condition, and the surgeon may compromise by a probably ineffective nerve graft. The importance of an early union after the division of a nerve is recognized. With chronic infection of soft tissue or bone, the delay of many months for healing to occur, and three or more months after healing for any latent infection to subside, may lead to serious or permanent degenerative change in the nerve. Peripheral nerves with their special intrinsic blood supply resist infection better than many other tissues, and to avoid a harmful delay,

Fig. 21. Illustrating the slack of 7 centimeters obtained in the musculospiral nerve by adduction of the arm.

Fig. 22. Neurorrhaphy. Exploration of a neuroma in continuity. The central portions (5) show on section complete fibrosis. At *3* and *6* the trunk is enlarged and hyaline. At points *2* and *7* a nerve bundle is found. The transverse sections are continued, a sharp razor being used until normal brush-like ends with absence of fibrosis are found at *1* and *9*, at which points the neuroma is excised.

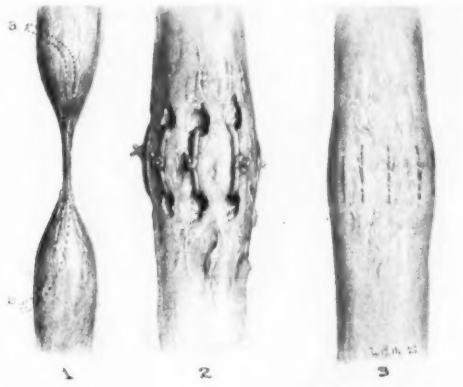


Fig. 23. Illustrating the reaction in peripheral nerve trunks from suture material. *1*, Sciatic nerve united by suture *à distance* with a large braided silk suture 5 months before. No reactionary degeneration of the nerve has been produced by this large non-absorbable suture which was introduced when the wound was debrided for gunshot injury in France. *2*, Showing pockets of liquefaction and absorption in the median nerve from a neurorrhaphy with chromic catgut performed 4 months before. The wound was free from infection, and while no abscesses were present the sutures have produced marked destruction of the nerve ends. *3*, Fine black silk sutures uniting the median nerve shown after 5 months. Absence of destructive action upon the nerve is evident. Catgut should not be used.

we have sterilized the suppurating wound with a solution of zinc chloride as elsewhere described,[1] operated on the injured nerve and have sequestered it in, or between healthy muscles. In one such case with ununited fracture and extensive suppurative osteomyelitis of the humerus following gunshot wound, regeneration with return of power to the brachioradialis and extensors of the hand, occurred within the usual time and there was no evidence of irritation or infection of the sequestered and sutured musculospiral nerve. With insufficient adjacent healthy soft tissue to surround the newly sutured nerve, as with a destructive arthritis, it may be impossible to protect the nerve, and delay until the infection is overcome is necessary.

Neurorrhaphy. In suturing a divided nerve, the ends are sliced back to a point where nerve bundles may be recognized everywhere within the sheath. The ends are trimmed square and accurately united. Usually after an old injury, the nerve ends are found bulbous or neuromatous, especially the proximal end. On section, the bulbous ends are found to be fibrous, and give no gross evidence of fasciculi. Next to the fibrous zone is an area in which the nerve bundles are apparent, but are œdematous or hyaline and fused together, and the diameter of the nerve is increased. This area of chronic neuritis may be very short or may extend a considerable distance along the nerve. Distal to the zone of injury, both above and below, normal appearing nerve bundles are found. The bundles are discrete, not fused, and on section separate slightly from each other and project from the cut surface, giving a stubby brush-end appearance. The nerve trunk may be swollen and larger than normal and have a slight yellowish tinge from fatty degeneration. The first fibrous zone bars the downgrowth of axons, and should be excised freely. Regeneration may take place through the second zone, and when there has been a widespread neuritis, it may be the only portion available for suture. While we have selected by preference the more normal third zone when the length of the gap did not preclude, the influence of the chronic neuritis of the second zone on regeneration has not been fully determined. The degree of neuritis at the point of suture with the degree of hyaline change in the bundles, and the diameter of the nerve trunks and nerve ends in millimeters should be recorded. If there has been a marked neuritis, and regeneration is not evident in a reasonable time, reoperation, excision, and resuture always should be considered.

The adjacent liquefaction necrosis and marked leucocytic infiltration produced by catgut is such that it should not be employed for nerve suture. In Figure 23 the pockets of leucocytic infiltration, liquefaction and absorption about five chromic catgut sutures are well shown. The catgut had been introduced several months previously. No other evidence of irritation was found about the healed nerve. In contrast we found no

[1] Babcock. The immediate sterilization of wounds. J. Am. M. Ass., 1920, lxxiv, 1301.

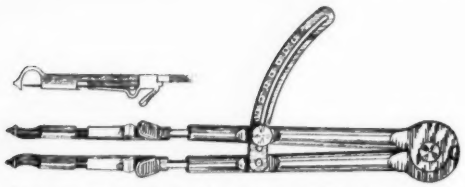


Fig. 24. Nerve clamp for holding peripheral nerve during suture. The nerve ends are transfixed by a very fine needle or steel pins and are gradually brought together as the nerve is freed. The clamp greatly shortens the time for suture and prevents displacement and disorientation of the nerve ends.

such local reaction about either fine or coarse sutures of silk that had been introduced in nerves. That chromic catgut is occasionally so harmful is enough to banish it as a nerve suture. Especially undesirable may be the zone of degenerative reaction produced by the transfixing suture used in the technique of Gosset. The argument that a transfixion is necessary to prevent cupping of the nerve ends and a failure of opposition of the central fasciculi has little practical basis. On the operating table we found little tendency toward a central cupping after suture of the nerve sheath alone, and a central separation of 1 or 2 millimeters filled by aseptic blood clot is no bar to the down growth of neuraxes, and may even be an advantage in better permitting the down growing axis cylinders more accurately to select the nerve bundle into which they properly should advance. A light contact of the nerve ends is to be preferred to a tight suture by which the nerve bundles are turned back or driven past each other.

Fine black sewing silk from No. 0000 to size A of good quality is sufficiently strong to suture the largest nerve, and if aseptic, produce very little reaction. We prefer many fine sutures to a few coarse ones. Fine arterial suture, however, is too delicate to suture any but the finest nerve branches. A straight No. 10 or 12 bead threading needle of short length, as is used in arterial suture, is preferred, a mosquito hæmostatic forceps being used as a needle holder. The suture penetrates the sheath but not the nerve substance and the number of sutures employed varies from 4 for a small nerve, like the musculocutaneous or internal saphenous, to from 20 to 35 interrupted sutures for a large nerve like the sciatic. In suturing, three or four guide or location sutures are introduced at nearly equidistant points, and then a sufficient number of intermediate sutures to give sufficient support. Intraneural suture is not very feasible or desirable. Care is taken to keep the edges of the nerve sheath everted so that no portion will be interposed between the fasciculi (Figure 24). The suturing is greatly facilitated by using a nerve clamp (Figures 24, 25, 26) which orients and holds the ends accurately together, facilitates the rotation of the nerve during suture, and relieves the early sutures of tension.[1] If undue force is used in attempting approximation by the clamp, the delicate holding pin will tear out or the nerve will be distorted. While the instrument removes all slack under light traction, it will not injuriously elongate a nerve. As the nerve is freed, the slack is taken up by tightening the instrument and the full effect of position and liberation of the nerve instantly shown. The union following suture of a nerve rapidly becomes strong, not so much from the early end-to-end union as from the adhesions that quickly form to adjacent muscles and other soft tissues. In a sutured sciatic nerve re-examined 20 hours after suture we found such firm fusion with the adjacent muscles that the line of union showed no strain when moderate force was applied to extend the knee. In this case soon after end-to-end suture for a 12 centimeter gap the patient had extended the thigh and, we believed, had torn the nerve ends apart. In a second case when the ward surgeon forcibly extended the elbow, 2 weeks after suture for a long gap in the median nerve, the adjacent adhesions were so strong that the nerve ruptured above, but not at the suture line. The fusion with adjacent tissues is so marked that we have found it difficult to isolate a nerve trunk a few weeks after operation. In time, the adhesions become less marked. A sutured nerve will not remain under tension; it will elongate or the line of suture give way. Elongation without damage to conduction rapidly occurs. Recall, for example, the very marked elongation of a sensitive seventh nerve by certain rapidly growing subtentorial tumors without facial palsy.

Elongation of a nerve after operation. The nerve is caused to grow longitudinally after operation by graduated and progressive movements of adjacent joints. The range of movement of the joint is increased two degrees on a measured arc each day, beginning 7 days after the operation. Thus if it has been necessary to flex the elbow to an angle of 90 degrees to obtain end-to-end suture of the median nerve, on the seventh day the restraint is so loosened as to permit movement to 92 degrees, on the eighth day to 94 degrees and 45 days later the elbow should be straight or at 180 degrees. This arbitrary rule which we adopted 6 years ago has in practice proved entirely safe. As would be expected, the regeneration will be

[1] Babcock. A nerve clamp. J. Am. M. Ass., 1919, lxxii, 1675.

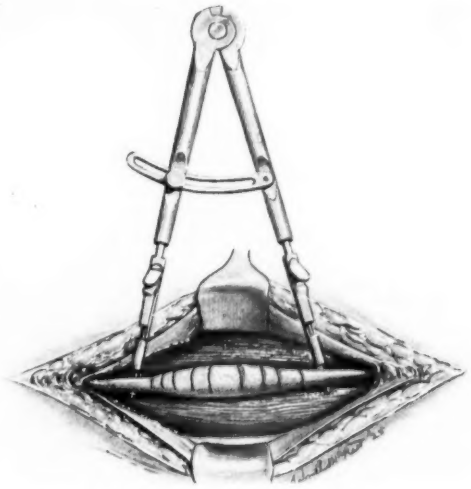


Fig. 25. Nerve clamp pinned to nerve distal to a neuroma in continuity which is being explored.

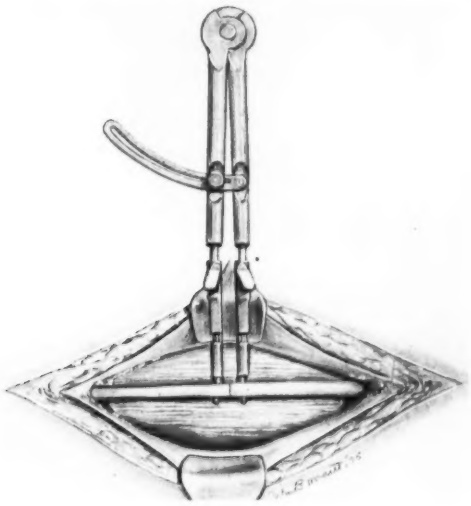


Fig. 26. The neuroma has been removed. The nerve ends accurately apposed by closing the nerve clamp, are in position for suture. The under surface of the nerve is exposed by rotating the clamp.

slower when the nerve has to elongate as well as to regenerate.

Causalgia may be due to adhesions, to compression, to a neuroma terminal or in continuity, or to a neuritis. A neurolysis, hersage, or even a resection and suture may be necessary. In neuritis a division of the sheath and limited hersage is useful. In one marked case with involvement of the sciatic, the nerve had been injected with alcohol several times without relief, but the pain promptly subsided when an overlooked neuroma in continuity was excised and the ends sutured. With partial division or obstruction in a nerve, it is wise to split off the injured from the functionating fasciculi and to do a partial or *measuring worm* suture as indicated in Figure 28.

A knowledge of the nerve pattern, Figure 1, is useful in partial suture and also in locating a partial obstruction. For example in a case of paralysis of the flexor carpi ulnaris only, the rœntgenogram showed a minute shell fragment in the region of the ulnar nerve near the elbow. As fasciculi for the flexor carpi ulnaris run in the anterior mesial segment of the nerve, (Fig. 1), in this case there was reason to believe that the fragment was imbedded in the anterior inner quadrant of the nerve, precisely where it was found at operation. A study of the nerve pattern also may be of value in locating the position of the fasciculi that are blocked, where there has been a partial return after performing suture.

The speed of regeneration down a nerve from the line of suture is about 1 millimeter a day or 1 inch a month. The downgrowth of certain sensory neuraxes is more rapid, so that deep pressure tingling (Tinel's sign, a pins and needle sensation where the skin over the nerve trunk is tapped distal to the injury) is in advance of the pain, tactile sense, and motor return; and usually indicates that they will follow in some degree at least. If no evidence of regeneration has occurred after twice the normal period of time has elapsed, the nerve should be re-explored by operation. For example, the radial nerve has been sutured 100 millimeters (4 inches) above the belly of the brachioradialis. Normally in 4 months, or 100 days, faint voluntary contractions of this flexor should appear. If, despite appropriate support to maintain relaxation of the affected muscle and massage, no voluntary contraction appears after 8 months, we would re-explore the area of suture, free the nerve cord, remove sources of pressure, split the nerve sheath through the zone of anastomosis and withdraw any visible sutures. We have seen a very rapid return of function after such secondary operation. Pressure from scar, or new callus, irritation from sutures, or other foreign bodies, evidence that the nerve ends were not sufficiently resected to remove all fibrotic or degenerative tissue, or, actual separation of the nerve may be found. In our series, if the divided

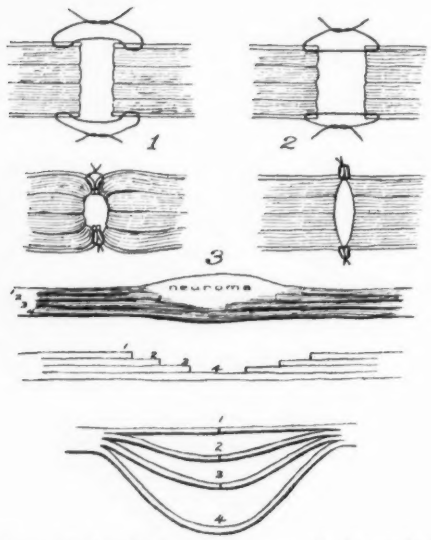


Fig. 27. Methods of nerve suture. *1*, Faulty method of suture of the nerve sheath producing inversion so that the sheath lies in the line of growing neuraxes; *2*, proper method of suture of the sheath with fine silk producing eversion. A 2 or 3 millimeter separation of the nerve ends is desirable to facilitate orientation in the downgrowth of neuraxes. *3*, Neuroma in continuity showing step resection without complete division of the nerve. This method enables any residual function of the nerve to be conserved.

nerve was sutured within 1 year from the time of injury, and there was no evidence of regeneration after the stated interval, exploration invariably gave a reason. While early nerve suture is desirable, a suture 1 year or more after the injury although less promising, should as a rule be tried.

The results after operation upon nerves with a simple function, as the musculospiral or posterior tibial, are, of course, much better than those upon nerves of complex function such as ulnar and anterior tibial. Possibly many of the partial results reported are due to technical errors as failure to match the nerve bundles in the end-to-end apposition, degenerative area in the nerve produced by catgut or transfixion sutures, failure to remove all neuromatous or degenerated tissue, an associated neuritis, muscle fibrosis, or other cause. In two instances ineffective operation had resulted because performed for a lower and minor lesion while the major and higher nerve lesion had been overlooked.

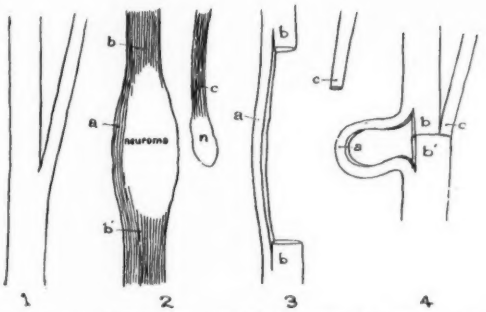


Fig. 28. Illustrating method of suture for neuroma in continuity. *1*, Nerve with branch before injury. 2, *a*, Nerve trunk with neuroma in continuity. *b*, Separated branch with terminal neuroma, *n*. 3, Illustrating section of neuromatous tissue. Branch showing at *c*. 4, Measuring worm type of suture with union of branch, *c*, to the distal end of the nerve.

SUMMARY

1. It is desirable that the technique for operations on peripheral nerves be standardized, not only to give the patient the greatest benefit from the operation, but to provide a uniform basis for evaluating and comparing the results from exploration, neurolysis, hersage, and suture.

2. An exploration should include the contents of the nerve sheath. Neurolysis also should include the opening of the nerve sheath, hersage a careful disassociation of the nerve fibers throughout the field of injury, neurorrhaphy an end-to-end matching of nerve bundles, the approximation being by fine silk introduced in the sheath only, without transfixion of the nerve and without the use of catgut or other exudate producing sutures.

3. A sutured or injured nerve should be placed in a normal intermuscular plane or buried in living muscle. Insulation of the section of nerve from adjacent sources of blood supply by cargile membrane, arterial tubes or tissue transplants not only interferes with the nutrition of the damaged nerve, but invites injurious local exudative reaction and absorptive processes.

4. Nerve grafting to bridge defects in peripheral nerves should be considered useless and unnecessary, and as such, should take its place with such discarded operations as *suture à distance*, substitution, and flap formation. As a rule the operator who resorts to nerve grafting should realize that he has probably failed to do what could have been done, that he has failed to avail himself of the full resources at his command. If it is impossible to bring together and suture divided nerve ends, then the limb usually will be found so disorganized that suture would be valueless.

5. Gaps much longer than heretofore thought possible may be closed without undue tension by end-to-end suture.

BILATERAL RESECTION OF THE MANDIBLE FOR PROGNATHISM[1]

By LOUIS SCHULTZ, M.D., Chicago
From the Department of Oral Surgery, University of Illinois

PROGNATHISM (*pro*, in front of; *gnathos*, jaw) is a comprehensive term used to define various malformations of, or malrelations between, the upper and lower jaw. Moorehead and Dewey (13) differentiate between physiological prognathism, an ethnological peculiarity, in which both jaws protrude, but there is normal occlusion of the teeth, and pathological prognathism characterized by protrusion of but one jaw and by abnormal occlusion of the teeth. The latter term includes facial deformities distinguished by a retrusion of either jaw with a real or only an apparent protrusion of the other. It also includes cases in which one jaw is normal, the other protruding, and finally cases of "open bite" with occlusal relation between the molars, sometimes the last molars only, all other teeth failing to meet.

For the sake of conciseness, this article is limited to the type of prognathism for which I operated, in the report of which I am describing and illustrating the technique used. This relates to a normal upper jaw with a protruding mandible and open bite. These cases are rare—hence the literature is not abundant. Yet, as Brophy (4) says, when extensive they belong to the most conspicuous and repulsive deformities of the face.

The etiology includes thumbsucking and similar bad habits in early childhood, enlarged tonsils, adenoids, mouth breathing, lack of dental care, especially that relating to the permanent first molars, resulting in a faulty bite. This may induce abnormal use of the muscles of mastication, the resulting stimulation causing overdevelopment of the jaw and failure of normal formation of its angle. Heredity may be a potent factor, so is atavism. The deformity may be an expression of certain diseases, such as rickets, acromegaly, cretinism, partial giantism, etc.; or it may be the result of trauma as when, after a fracture, union of malposed fragments is permitted. Blair (3) also points out that contracting scars from burns on the neck and chin can greatly deform the developing jawbone.

The diagnosis is made on sight.

The prognosis varies. Mild cases in young individuals usually can be successfully cared for by the orthodontist. Certain adult cases can be corrected by surgery. In such, the prognosis is good. In others it is only fair.

Treatment relates to the use of appropriate orthodontic appliances, traction on the protruding chin at night by means of a headcap and chinstrap when indicated. In older patients, however, after the bones have hardened, surgery offers the only means of correction.

The first surgical operation on record for such a case was done by Hullihen (11) in 1848.

Babcock (2), of Philadelphia, has corrected this deformity. He did it by section of the rami followed by wiring the teeth in occlusion.

But to V. P. Blair, of St. Louis, belongs the credit of first conceiving the plan to correct such deformities by shortening the body of the mandible by bilateral resection. He proved the soundness of his concept by successfully performing the operation, making all interested surgeons his debtors, an obligation which I freely acknowledge. His operation consists in removing a suitable section in the second bicuspid region on each side and adjusting the anterior segment to the posterior ones. They are immobilized by wiring the fragments together and the lower teeth are fastened to the upper ones either by wiring or by an appliance cemented to the teeth. He has performed this operation more often than any one else.

Harsha (9, 10), of Chicago, in 1912 reported a case which he corrected by removing sections from the body of the mandible at the angle, preserving the nerve.

Gilmer (8), of Chicago, in 1915 reported a case of upper retrusion with lower protrusion. He removed sections at the angle reducing the enlarged mandible to normal size and secured an ideal surgical result. He does not state whether

Fig. 1. Photograph of patient before operation.

[1]Read before the Chicago Medical Society May 26 1926

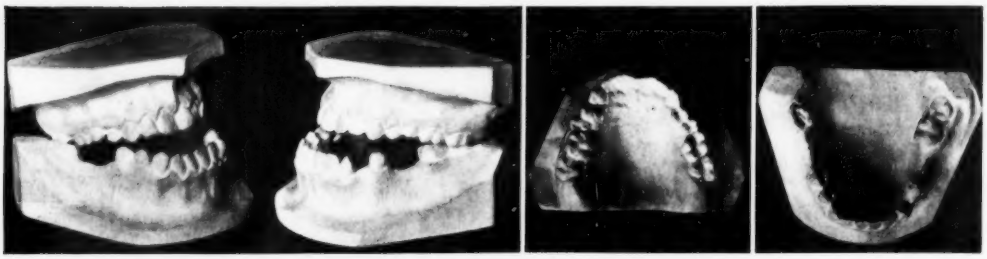


Fig. 2. Impressions of patient's mouth before operation.

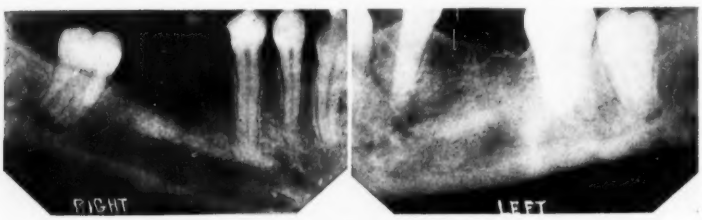


Fig. 3. Roentgenogram of teeth.

or not this was followed by an orthodontic correction of the retruded maxilla, but if it was it must have resulted in a perfect profile.

Aller (1) resected a V-shaped piece in the second bicuspid region on each side intra-orally with good result.

Gessner and DeVerges (7) reported a case done under local anæsthesia after Blair's method. With a metacarpal saw, sections were made through the bicuspid sockets and the reduction of chin and anterior teeth accomplished.

Pichler (15) mentions Blair and others who operated on similar cases and comments on their technique. He operated under local anæsthesia, conductive type, doing a submucous resection.

Floris (6), of Hamburg, reports a case successfully done by Kuemmell. The deformity was corrected by a unilateral resection. He intended doing the operation in two steps. However, union of fragments was delayed and complicated by repeated breaking of wires used to immobilize the fragments. The patient refused a second operation declaring herself satisfied with the result of the one operation.

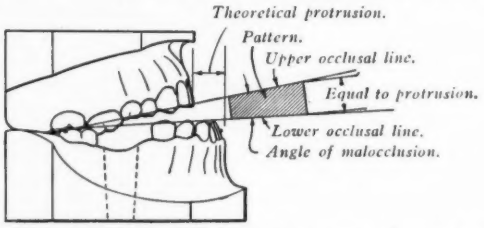


Fig. 4. Diagram showing scientific manner of preparing patterns for correction of deformities of this nature.

Pickerill (14) removed a section in the first bicuspid area, doing one side at a time but did not get a perfect result.

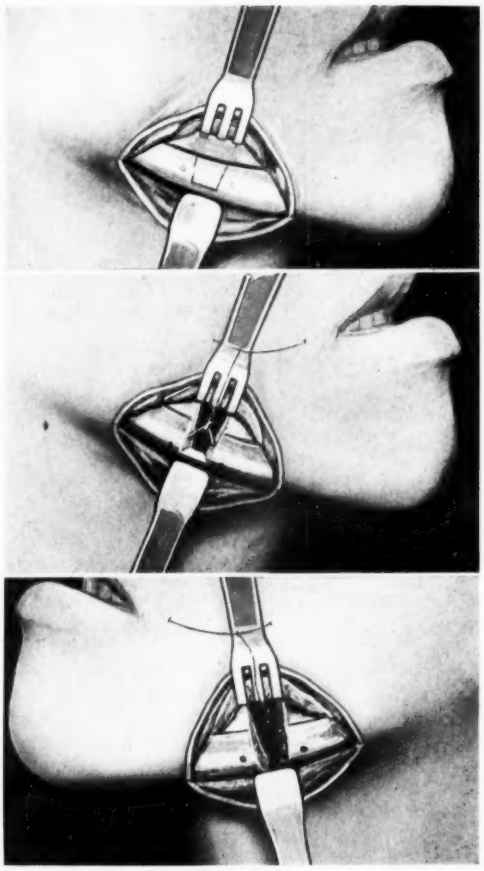
Dufourmentel (5) calls attention to the dangers of the correction by bilateral resection of the body. He recommends as best his operation of double resection of the condyles and reports 5 cases he corrected this way since 1917. There is no fracture of the body, no danger of ankylosis, and motion is not impaired. But the teeth cannot be brought into occlusion, though the protrusion is reduced. The open bite must be corrected by orthodontic means.

Julliard (12) reported a case of double resection before the French Surgical Congress. He did it extra-orally under local anæsthesia, making some cuts with a Gigli saw, and some with a circular one. He reports good æsthetic and functional effect.

It seems that each operator has adopted a technique which varies somewhat from that practiced by others. I also have found it expedient to do this.

A report of my case follows:

Miss C. C., age 19, referred to me by Dr. R. C. Willett, of Peoria, about 2½ years ago. The mother died of tuberculosis and other members of family are tuberculous. Patient had rachitis and diseases of early childhood. Later



Figs. 5, 6, and 7. Technique of removing segment of bone.

at three different times she sustained long bone fractures during play from falls which, in a normal child, would not have resulted in any serious injury. Patient suffers from an inferiority reaction rapidly leading to manic-depressive psychosis, with depressed phase.

Examination shows an emaciated patient, suffering from anæmia (Fig. 1). This is due partly to chronic hypertrophy and infection of her tonsils partly to inability to masticate. Occlusion relates to one upper molar on each side, all other teeth do not meet (Fig. 2); the lower incisors project 1 centimeter in front of upper in isors; the chin is too low and too prominent. The deformity developed gradually beginning during the period of first dentition and continued until she was about 17 years of age. The arch of the upper jaw and roof of the mouth are within normal limits. The absence of other bony enlargements, the age of the patient, the time of onset, etc., preclude the diagnosis of acromegaly.

The indications for surgical interference were threefold: (1) to establish occlusion of lower with upper teeth so she could masticate food; (2)

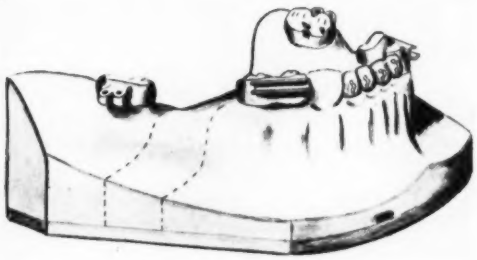


Fig. 8. Cast with anchor bands as placed before operation.

Fig. 9. Roentgenogram showing condition after operation.

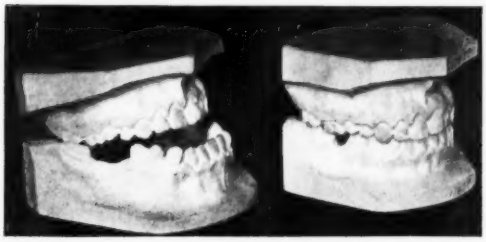


Fig. 10. Casts showing occlusion before and after operation.

to correct the deformity—a question of æsthetics; (3) and most important—to change the mental symptom complex.

Figure 3, a roentgenogram showing that the right lower second molar had been extracted just before the case came under my observation. The left lower first molar was pulpless, contained incomplete root canal fillings and showed rarefied areas around the apices, therefore I had that tooth extracted. I asked Dr. Willett to retain both spaces. The lower third molars were in process of eruption. During this time of preparation her tonsils were removed.

I felt that neither Babcock's operation, consisting in severing the ramus horizontally above the mandibular foramen, nor the technique

Fig. 11.

Fig. 11. Roentgenogram after operation showing good occlusion. The jaw had united on both sides, and splendid masticatory function had resulted.

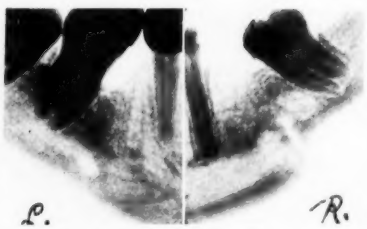


Fig. 12. Fig. 13.

Figs. 12 and 13. Roentgenograms 9½ months after operation showing almost complete obliteration of line of resection of jaw.

employed by Harsha removing a rhomboid section from the body of the jaw between the last molar and the ramus, would produce the best results in this case. In the former it was not advisable because an appreciable gap would be caused in the ramus by raising the resected segment to bring the anterior teeth into occlusion, which in healing would tend to separate the anterior teeth during the period of contraction of the maturing tissue, in the latter, or the Harsha operation, because there was not sufficient room between the last molar and the ramus to remove a rhomboid section of proper size. Nor did Gilmer's method seem adapted to produce an ideal result in this case since the lower molars containing vital pulps were in good position anteroposteriorly so far as occlusion with the upper ones was concerned. I decided therefore on an operation along the lines followed by Blair, only instead of having normal bicuspids removed I preferred to accept the handicap of a larger anterior fragment deprived of its principal nerve and blood supply for the sake of utilizing the space created by the extraction of the right lower second molar and ridding the patient of a questionable lower first molar. All the remaining lower teeth contained vital pulps.

Fig. 14. Photographs taken 1 month after operation.

Patient came to city June 15, 1925. I carefully studied the relation of the lower to the upper teeth and prepared two wedge-shaped patterns, one for each side, marked *R* and *L* respectively since there were slight variations between the right and left sides. Figure 4 shows scientific manner of preparing patterns for correction of such deformities. These patterns were made 1 centimeter at widest end to correspond with the actual protrusion, and at the time of operation I had them included with the instruments for sterilization.

Operation was done June 16, 1925, under aseptic ether anæsthesia. A longitudinal incision was made in the shadowline of the jaw, 2 inches long down to, but not including, the periosteum. The external maxillary artery was cut on the right side and both ends were tied. The tissues were stripped up from the jaw to a point half way between the lower border and the alveolar crest, both on the buccal and lingual surfaces. The periosteum was divided at that level and all the soft tissues in the alveolar region peeled from the bone, as recommended by Blair, care being taken not to penetrate into the mouth cavity at any point (Fig. 5). An assistant placed his finger in the mouth of the patient and into the space caused by the extraction of the molar, thus guiding a small dull ended instrument which I introduced into the wound into the center of that space. With this aid I placed the copper plate pattern for this side in place and with a scalpel marked off the section to be removed. A crosscut fissure-bur, revolved by a dental engine, made both cuts through the external plate; with a chisel I connected the cuts at the lower border and pried out that section of bone bringing the inferior alveolar vessels and nerve into view. Passing a ligature under these structures, I tied them out of the way (Fig. 6). I repeated the same technique

Figs. 15 and 16. Scars on right and left sides resulting from suppurating wounds.

Fig. 18. Photograph after correction of scars.

Fig. 17. Recent photograph of patient with pantographic drawing superimposed.

on the left side. However, I dissected out the external maxillary artery on this side, and tied and cut it between ligatures. I then removed the remaining portion of the section of the left side with rongeurs and bone cutting forceps after drilling a hole through each segment near the lower border for the purpose of immobilization. In removing this portion of the bone, I inadvertently cut the vessels and nerve, so I excised all of the exposed portion (Fig. 7). Instead of silver wire I used kangaroo tendon to hold the fragments in apposition, securing the ends in a hæmostat after adjusting the first loop of a surgeon's knot. Next I finished the other side in the same manner except that I did not cut the vessels and nerve, but instead cut a groove in each fragment and looped the nerve and vessels on the buccal surface of the bone. The anterior fragment was now brought back and up so that the teeth occluded, and Dr. Willett locked the teeth in position with a bar fastened to bands he had previously cemented to the teeth (Fig. 8). Finally the kangaroo tendons were tied and the wounds closed. The cut ends lined up perfectly, although the lower border of the jaw did not but no attention was paid to that for good occlusion was paramount as shown in Figure 9. Figure 10 shows occlusion before and after operation.

Postoperative treatment consisted in wiring the lower teeth in occlusion with the upper ones after all danger of nausea from ether had passed, the application of cold to the wound for the first 24 hours followed by boric acid fomentations and irrigation of mouth with hot boric acic solution. There was no elevation of temperature, no swelling, no pain.

On the fifth day I removed the stitches to prevent scar formation. On the eighth day the left side became painful, swollen, and the wound opened discharging pus. On the ninth day the right side did the same. Discharge stopped on right side in two days and wound healed. The left side kept discharging for a month when the kangaroo tendon came away and it closed; a month later two small sequestra were cast off and the patient went home. The jaw united on both sides, with splendid masticatory function, because the teeth were placed and held in good occlusion as shown in Figure 11. Figures 12 and 13, roentgenograms made 9½ months after operation, show an almost complete obliteration of the line of resection by new bone. Tonus and feeling returned in the lower lip during the first week, the side where nerve and vessels were cut being more advanced in its return to normal than the other. Figure 14 shows correction of deformity 1 month after operation and Figures 15 and 16 show scars on right and left side resulting from suppurating wounds. Figure 17 is a photographic profile view

as it is now upon which a pantographic drawing was superimposed. The photographic view as it was before operation was used in order to outline the correction in the most accurate manner. It shows an exact reduction of the chin of 10 millimeters, corresponding to upper width of patterns used in the operation.

Five months later the patient returned, and I removed both scars, closing the wounds with Halsted's subcuticular suture. Recovery was uneventful (Fig. 18). A comparison of Figures 1 and 14 will show what has been accomplished for her.

The result obtained was made possible only by close co-operation with Dr. Willett, the orthodontist who cared for the immobilization of the fragments, etc., after the patient went home. Indeed, I feel that with such splendid co-operation all other fixation methods, contemplating the lashing together of the bone fragments by means of kangaroo tendon, silver wire, etc., passed through previously drilled holes, may well be dispensed with, provided always that the patient has a sufficient number of firm teeth on which the appliance may be cemented.

The three indications for surgical interference have been met: (1) firm union, perfect articulation, and splendid masticatory function were obtained; (2) the deformity was entirely corrected; (3) the desired mental change resulted, for whereas the patient prior to our treatment was a mental liability she now appears as a mental asset—a comfort to herself and to her friends.

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A METHOD OF TREATMENT OF OLD INFECTED COMPOUND FRACTURES OF THE TIBIA

By LAWSON THORNTON, M.D., Atlanta, Georgia

COMPOUND fractures often become infected, even under the most favorable antiseptic and aseptic care. The infection may subside or persist as a chronic suppurating bone sinus. Union of the fracture may occur but often the ends of the fragments become bound together by dense scar tissue. Bacterial invasion of the bone is usually limited to an area adjacent to the fracture. Compound fractures most frequently occur in the tibia. In our experience with old compound infected fractures of this bone, a plan of treatment has been evolved which has given uniform results. None of the procedures employed is original.

The infection is first cleared up and the wound allowed to heal. This is accomplished by a sculptural operation very similar to that employed in our treatment of chronic osteomyelitis. After the wound has healed, a brace is worn during that period of time when latent infection may be present. When this danger has passed, a massive inlay bone graft is made to bridge the bony defect at the site of fracture, and the brace is again worn until union has occurred and the strength of the bone assured.

Before attempting a sculptural operation for clearing up the infection, an accurate conception of the location and extent of the diseased bone

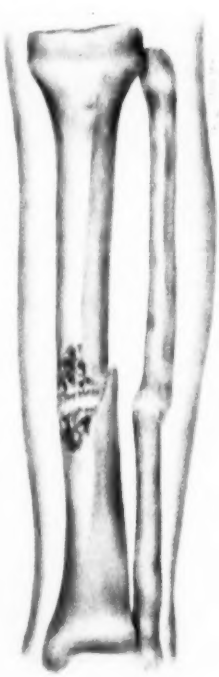

Fig. 1.

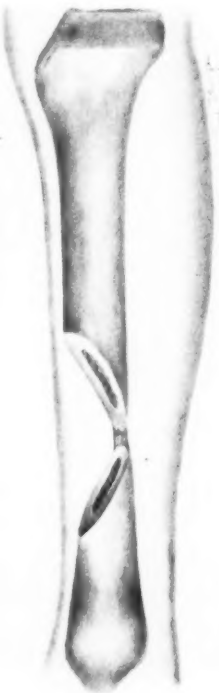

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. Showing compound infected fracture with fibrous union.

Fig. 2. The sculptural operation completed. The diseased bone has been carved away, leaving the long sloping surfaces to heal by granulation.

Fig. 3. After the disease has been cleared up and wound has been completely healed for a sufficient period of time to justify the step as regards latent infection, a massive inlay bone graft is placed to bridge the bone defect.

Fig. 4. The inlay bone graft.

Fig. 5. Roentgenogram of a typical old infected compound fracture with sequestra and infected bone sinuses.

Fig. 6. Roentgenogram of same tibia as shown in Figure 5 some time after sculptural operation had been done, and after wound had healed by granulation.

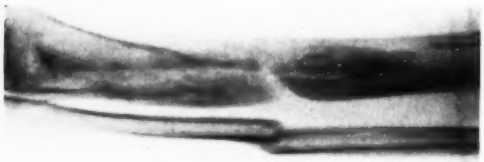

Fig. 7. Roentgenogram of same tibia as in Figures 5 and 6, showing inlay bone graft. The tibia is united with firm bony union.

and bone sinuses should be obtained by careful roentgenographic study. The bone is freely exposed subperiosteally over the anterior cortex, and is so carved with a sharp chisel that all diseased bone is removed and all deep recesses obliterated. This usually leaves the exposed bone a shallow depression with long sloping surfaces, much as if two chisels were placed with their cutting edges together. These sharp edges may be continuous bone or may be held together by dense fibrous tissue. . . . When the operation is completed, the wound is packed with gauze and a plaster cast is applied to the extremity, extending from the upper thigh to the toes. On the fifth day, the wound is dressed through a window in the cast. Thereafter daily dressings are made which consist in cleansing the surrounding skin and gently packing the wound with vaseline gauze. The wound is allowed to heal by granulation.

When healing of the wound is complete, a leather-steel brace is applied, which is attached to the shoe and has motion at ankle and knee; the patient is gotten up with crutches and dismissed from the hospital.

After sufficient time has elapsed during which latent infection might be encountered, a massive inlay bone-graft is placed to bridge the bone defect. This period of time varies according to the individual case. Three to twelve months are usually required, and the longer the delay the less danger there is of latent infection. A very large, broad graft is most desirable because it must eventually bear much of the weight of the body. If, for any reason, a graft of sufficient size cannot be obtained from the fractured tibia, it should be taken from the opposite leg.

In those cases in which a fracture of the fibula has also occurred, it is usually found to be united with malposition. It may be necessary to correct the alinement of this bone, but unless it causes deformity, our plan has been to disregard it.

After the bone graft operation, the extremity is immobilized in a plaster cast for 8 weeks, and then the brace is reapplied and worn until the roentgenogram shows that the graft has assumed the structure and density of normal bone.

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THE TECHNIQUE OF CAUTERY AMPUTATION OF THE CERVIX

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THE easiest and most efficient method of removing the cervix uteri, in the presence of suspected malignancy, is by the actual cautery. With a Downes' cautery blade, curved slightly, just at red heat, a complete amputation of the cervix at the level of the internal os can be done in 15 minutes with no hæmorrhage and no shock. The resulting specimen is the cervix *in toto* which lends itself to thorough microscopic examination.

In the early stages of malignancy, a cure can be effected in a certain percentage of cases by this simple procedure. If the malignancy has extended beyond the level of the cautery, no harm has been done because no living cancer cells have been transplanted.

The technique is exceedingly simple. The only instruments are a heat controlled cautery knife, a weighted speculum, and two ordinary right angled retractors. Water cooled specula are not necessary. The procedure can be easily carried out under anæsthesia induced with gas oxygen, and there is no pain whatsoever following the operation.

The patient should remain in bed a week or until the small eschar has separated. There has been no hæmorrhage in any of our cases either at the time of operation or during the period of healing.

INDICATIONS

The operation is indicated when the woman is past the climacteric, when malignancy is suspected, when the cervix is badly eroded, and when epitheliomata of the cervix, both in the early and the fairly well advanced stages, are present. The procedure should not be carried out before the climacteric unless a supravaginal hysterectomy is to follow, because the cicatrization invariably closes the uterine canal.

TECHNIQUE

After the ordinary preparation of the perineum, the cervix is grasped with five-pronged vulsella forceps. We have found Outland's vulsella excellent. Sharp traction is made and with the cautery at the proper heat (dull red) and controlled by a nurse at the operator's left elbow, the line of cauterization is carried along the junction of the vesical fold, coning upward toward the canal. This line of cauterization is carried completely around the cervix, at least 15 minutes being required for its completion. The resulting specimen is not unlike an acorn in contour. The vagina and cervix are packed loosely with gauze saturated with bipp paste. Healing takes place rapidly and outside of rest in bed and occasional douches, nothing further is to be done.

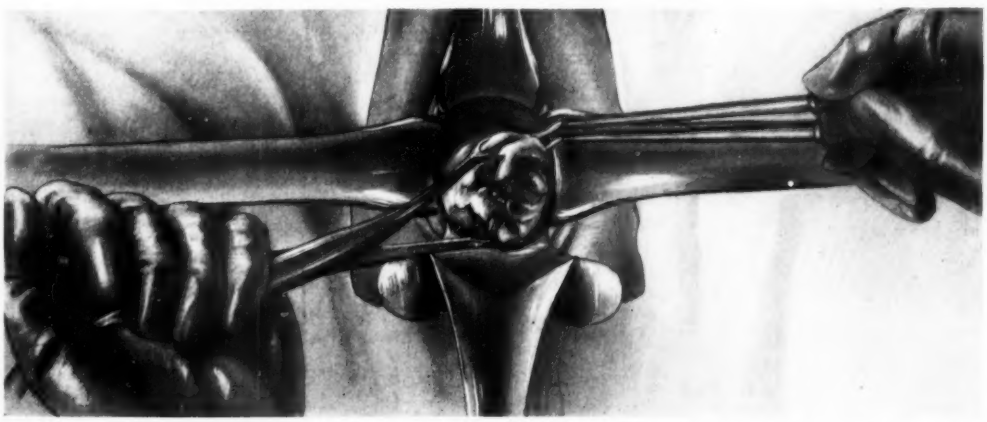

Fig. 1. Showing method of grasping cervix with large non-crushing vulsellum (Outland's) and arrangement of retractors. It will be noted that insulated or water cooled retractors are not necessary as the heat is in the knife.

Fig. 2. Showing the depth of amputation to the internal os. Note the cone-shaped extraction.

Fig. 3. The Downes cautery knife used with the rheostat. Very careful control of the heat is important as only sufficient heat is used to cauterize. Too much heat will allow hæmorrhage.

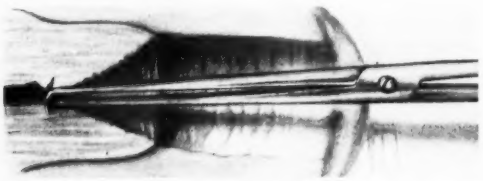

Fig. 4. Method of application of vulsellum forceps to get traction for observation of amputated stump.

Fig. 5. Fig. 6.

Fig. 5. Typical specimen. It should take about 10 to 15 minutes to remove the average cervix and there should be no hæmorrhage on completion.

Fig. 6. Typical specimen of suspected malignancy.

In a few cases we have used the radium bomb which is made of non-vulcanized rubber or patching rubber which has incorporated in it the necessary amount of radium. This bomb can be used immediately following the amputation or at the end of 2 weeks. We do not believe that this method of radium application is necessarily any more satisfactory than the usual method of placing radium needles, but it certainly gives excellent radiation.

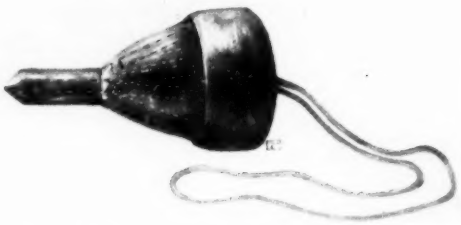

Fig. 7. Radium bomb showing radial placement of radium needles with one needle pointing into the uterine canal.

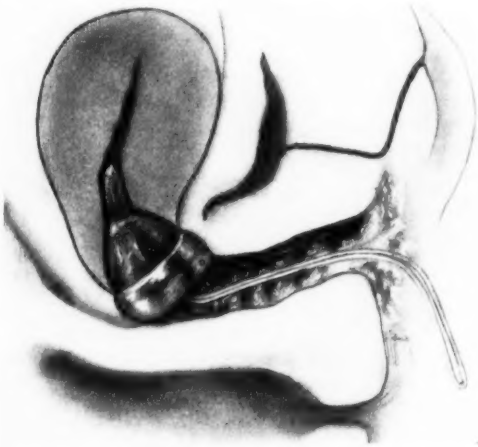

Fig. 8. The radium is inserted either in this matrix or as needles into the body of the uterus. One radium needle must be placed in the cervical canal.

TRAUMATIC SYMPHYSIOTOMY

By R. J. WILLAN, M.V.O., O.B.E., F.R.C.S. (Eng.), Newcastle-upon-Tyne, England
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TRAUMATIC separation at the symphysis pubis, without a concomitant fracture of the pelvic ring posteriorly, is a rare occurrence. Ordinarily, little can be done in the way of treatment of a fractured pelvis, when the pelvic ring is fractured both anteriorly and posteriorly. For the bulk of fractures of the pelvis, the method I now describe would certainly not be suitable.

I have seen only two cases of traumatic pubic separation, and these came under my care within a year of one another. I had long ago thought out how such a case should be treated and these thoughts were successfully translated into practical use when the occasion arose.

The apparatus (Fig. 1) was devised to approximate, and keep approximated, the separated pubic bones. It consists of two concave steel plates, *A*, *A*, joined together anteriorly by a steel spring, *B*, *B*, *B*, so as to form a clamp. The strength of the pressure from the clamp is regulated by a threaded bolt and flanged screw nut, *C*. The steel plates are heavily padded with thick felt, A^1, A^1, and are fitted to the patient into the space between the crest of the ilium and the upper margin of the femoral great trochanter.

The clamp was worn as tightly as the patient could bear it for the first few days, after that the tight clamping was not so necessary. Radiograms were taken at intervals and note taken of the size of the gap between the two pubic bones. Figure 2 is a photograph of Case 2, wearing the clamp.

It is difficult to gauge when a torn interpubic ligament unites. The period I had in mind was about 8 weeks. In Case 1 the period observed was 3 months, while the clamp was discarded by the patient in Case 2 in 7 weeks. As the time observed in Case 2 was effective, it would appear that 2 months is an adequate time.

In Case 1 the skin was inclined to become sore from the continuous pressure of the clamp. To ease this pressure on the soft tissues between the iliac crest and the femoral trochanter, a second clamp was occasionally applied during the course of each 24 hours at the level of the femoral trochanters: this enabled the clamp proper to be removed, when the skin could be rubbed with methylated spirit. In Case 2 there were no pressure symptoms whatever, notwithstanding the fact that the clamp was kept applied continuously until finally discarded.

Case 1. Colonel J. F. R., aged 40, was admitted under my care to a Private Hospital on April 3, 1925.

Some two or three hours previously, while hunting, he was thrown from his horse, when his outstretched hands and feet reached the ground simultaneously; his knees being fully extended at the time. His horse then rolled on to him, its weight being applied to the patient's sacral area when he was in this stooping position. Being a powerfully built man of 15 stones his lower extremities with extended knee joints were able to sustain, temporarily at any rate, the weight of the horse. But he experienced very acute pain in the pubic area, also in each groin, particularly in the left side. He was forced to the ground and found himself unable to stand up on account of the acute pain. He was removed to hospital in an ambulance.

When I saw him first he was suffering from severe shock. He was exquisitely tender when the pubic region was palpated: acute pain was felt in the same area on inward pressure being applied simultaneously to each side of his

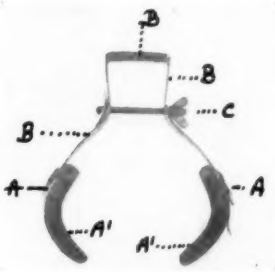

Fig. 1. Photograph of clamp.

Fig. 2. Photograph of patient with clamp applied.

Fig. 3. Roentgenogram of Case 2, showing wide separation of pubic bones.

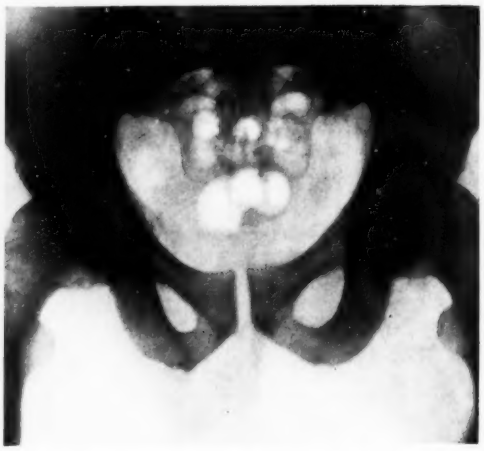

Fig. 4. Roentgenogram of Case 2, showing no gap in pubic bones.

pelvis, also when pressure was applied upward to the sole of each foot. There was no rigidity of the abdominal wall muscles and a rectal examination disclosed nothing abnormal. X-ray examination immediately after admission disclosed a separation of the pubic bones to the extent of about 1 inch.

As a temporary measure a strong webbing belt, with three buckles, was applied around the pelvis.

For the first 36 hours he vomited altered blood on several occasions. In the absence of muscle rigidity of the abdominal wall, the view was taken that the vomiting was due to shock: this interpretation of a disturbing symptom proved to be correct.

For the first 4 days there was retention of urine, requiring regular catheterization: normal micturition then became established and there was no further trouble. He had marked ecchymosis in each inguinal area which did not finally disappear for weeks. He also complained of a "pricking" pain in the left groin which persisted for months.

The clamp described was applied a few days after the accident and he wore it for 3 months. He was kept in bed for 11 weeks, after which he began to get about on crutches, but still wearing the clamp. The clamp was replaced by a thin leather pelvic girdle, which he still wears.

The pubic area was examined at intervals by means of the X-ray which showed the continued approximation of the pubic bones. A recent radiogram now shows a normal symphysis pubis.

He resumed his full military duties 6 months after the accident.

His present condition can best be described by quoting an extract from a letter written to me by the patient under the date of September 2, 1926; i.e., 17 months after the accident.

"I am glad to say I am getting on very well I think. I still go carefully and I daresay I could do a lot more than I do, but every now and then I get a bit of a reminder which makes me slow up at once. I ride for an hour or two practically every day and have done now for the last 3 months. After 2 or 3 hours the pelvis begins to ache a bit, but I suppose that is natural, also if the horse shies or gets bobbery it hurts a bit, but soon goes off, i.e., sudden strain the inside of one leg, but that improves.

"One day I was playing squash racquets and the pain started badly. Anyhow it was not in the pelvis and I got annoyed and went on with my game and let it hurt, which it did considerably. Next day it was all right and I have not felt it since!"

CASE 2. William R., aged 52, was admitted under my care to the Royal Victoria Infirmary, Newcastle-upon-Tyne, on March 24, 1926. On the previous day he was thrown from a horse. The horse "half went down toward its off side": the patient tried to keep in the saddle, when all the weight of his body (he weighs 13 stones) was taken by the left leg and thigh. He heard and felt a sharp "crack," he had very acute pain at the symphysis pubis, which caused him to faint. He thinks he fell on his right shoulder, and he rolled clear of the horse. He attributes the accident to his trying to hold himself in the saddle.

After recovering from the faint he tried to pull himself into an upright position by holding on to a gate, but the pain in the pubic area was so intense he had to desist. He found he could only stand if he was strongly supported on each side by two men, and he subsequently walked some distance with such support.

On admission he was obviously in great pain. Lateral pelvic pressure caused acute pain in the pubic area: on palpation of the pubes, the examining fingers entered deeply into the gap caused by the wide separation of the pubic bones. Defæcation and micturition, also his urine, were normal. X-rays showed wide separation of the pubic bones (Fig. 3).

The clamp was applied next day and was screwed tightly up. He immediately expressed great satisfaction at the comfort it gave him. As he suffered no discomfort from the pressure of the clamp this was not removed at all until it was finally discarded, seven weeks after its first application.

Seen on September 29, 1926, he was walking normally and was carrying on his work as usual, with the exception that he has not yet ridden a horse. He was not wearing any kind of pelvic support. Examination showed the pubic bones easily palpable with no gap between them. A roentgenogram (Fig. 4) taken at this date confirmed this.

I am indebted to the Radiological Department of the Royal Victoria Infirmary, Newcastle-upon-Tyne, for the radiograms.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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SEPTEMBER, 1927

THE IMPORTANCE OF CLINICAL INVESTIGATION OF SYPHILIS

EVEN with all the refinements of the laboratory study of syphilis, the scrutinizing clinical investigation has not lost its importance any more than in the investigation of other diseases. It is surprising how often the physician fully conversant with the various manifestations of syphilis can find clues to the disease before laboratory study of any kind has been made. The pathognomonic signs are so rare in syphilis, however, that conclusions cannot be drawn unless the evidence is judiciously weighed. Since irregularity of the pupil does not necessarily indicate syphilis even when associated with periodic attacks of vomiting, nor every hyperkeratotic patch on the mucous membranes syphilitic leucoplakia, such signs should set the full diagnostic mechanism, both clinical and laboratory, into motion.

There is considerable justification for the impression that the average physician, be he practitioner or specialist, does not make full use of clinical diagnostic methods. This seems to be more attributable to his mental attitude than to lack of knowledge of syphilis. Possibly the unusual value of the Wassermann test as a laboratory aid has somewhat unbalanced his best judgment.

It is apparently necessary to reëmphasize the importance of a suspicious attitude and the search for signs other than those presented for therapeutic consideration. This would of course include a painstaking elicitation of the history.

The suspicious mental attitude is justified by the fact that on conservative estimate, there are about ten million persons infected with syphilis in the United States alone. Considering the peculiar course of the disease and that so many persons are afflicted with it, it is clear that any physician should expect a reasonable proportion of it in his clientele. The specialist insists that unless the diagnostician is constantly on the alert for the disease it is often missed. This does not mean that the presenting complaint is always due to syphilis but, in a certain percentage of such cases, it is. Not uncommonly the syphilis in such a case is of more importance to the patient so far as his future welfare is concerned, than the complaint for which he consults his physician.

It is then only fair to the patient that the physician in this suspicious attitude take a careful history and search for confirmatory signs. Careful examination is probably the most important and should be completed first; the physician will thus avoid being influenced too strongly by the patient's interpretation of his previous symptoms which in many cases is almost worthless. Not only will the easily visible areas bear inspection,

but the scalp, neck, axillæ, penis (especially the meatus and glans), scrotum, pelvis, inguinal folds, perineum, anus, the readily accessible mucous membranes, and the palms and soles, when exposed seriatim and subjected to a careful scrutiny, will often disclose an unsuspected lesion. Scars may prove valuable diagnostic aids; search for lymphatic and bony enlargements and vascular engorgements should be a part of the routine. Finally the rudiments of a neurological examination are indispensable: the pupillary reflexes, the biceps, patellar and Achilles reflexes, ankle clonus, the Babinski and the Romberg signs and the simpler tests for sensory disturbance. It is surprising how often evidence in favor of syphilis is disclosed by such a search when casual inspection has not shown anything. If such an examination is followed by a painstaking investigation of the personal and family history, the examiner will frequently be spared the chagrin of having another physician readily discover syphilis which he has overlooked. W. H. Goeckerman.

SURGERY OF THE SYMPATHETIC NERVOUS SYSTEM

THE terms sympathectomy, sympathetic ganglionectomy, ramisectomy, and perivascular neurectomy are being seen in medical literature more frequently of late because of the renewed interest in surgical treatment of the sympathetic nervous system. Various surgeons have advocated cervical sympathectomy for exophthalmic goiter, glaucoma, epilepsy, and so forth, and the results have been more or less unsatisfactory, aside from cervical sympathectomy for angina pectoris. Removal of the left superior cervical sympathetic ganglion has afforded complete relief from anginal pains in a few cases, while in others it has been necessary to remove also the middle and the inferior cervical ganglia; yet, complete cervical sympathectomy fails in most cases. A few patients have been relieved, either completely or partially, by the removal also of the right cervical chain.

The indifferent results are probably due to the various etiological factors producing the typical anginal attacks. In a few cases the anginal pain has a vasomotor basis and appears to be similar to the pain associated with the vasomotor disturbance in Raynaud's disease. This explains the relief afforded by excision of the left superior cervical ganglion, since it gives off the accelerator nerves to the anterior cardiac plexus which also contains vasomotor fibers for the left coronary artery. The neurectomy relieves the vasomotor spasm of the coronary artery and the relief appears to be similar to that obtained from lumbar sympathetic ganglionectomy in Raynaud's disease of the lower extremities. Since anginal pain is usually due to arteriosclerosis of the coronaries and the arch of the aorta, and to myocarditis, or degeneration of the myocardium with or without coronary sclerosis, relief would not be expected from superior cervical ganglionectomy, since it is impossible to relieve intermittent claudication in the lower extremities when it is due to arteriosclerosis, by lumbar sympathetic ganglionectomy. The reason patients suffering with angina pectoris from lesions of this type are occasionally relieved by removal of the stellate ganglion is, no doubt, that the surgeon has been able not only to remove the stellate ganglion but to interrupt the afferent sensory fibers from the heart. These sensory fibers are not constant in their course; frequently they pass into the stellate ganglion; at other times they pass through an intrathoracic sympathetic ganglion on to the upper dorsal roots. This intrathoracic sympathetic ganglion, although communicating with the stellate, is

often separated from the stellate and is situated just below it. Danielopolu relieved a patient suffering from angina by injecting the upper six dorsal roots at the intravertebral foramen on the left side with a local anæsthetic. Similar results have been obtained from the injection of novocain followed by alcohol. However, it is difficult to differentiate the various etiological factors of true angina pectoris. There may be marked pathological change within the heart, and superimposed on this a mild vasomotor influence, or the reverse be true: the pain may be due chiefly to the vasomotor disturbance in early arteriosclerosis or to mild myocarditis. It is obvious that anginal pains due to vasomotor spasm occur in middle age with little or no arteriosclerosis of the coronaries, and in such cases patients continue to live for years, without pain, after operation; nevertheless the course of the disease continues and the patient dies very soon as a result of the cardiac lesion.

Jonnesco and Leriche suggested perivascular sympathectomy and perivascular neurectomy for Raynaud's disease, for pain due to arteriosclerosis, for thrombo-angiitis obliterans, for scleroderma, for causalgia, and so forth. Since then, many other surgeons have employed similar procedures. Again the results have been more or less indeterminate. Occasionally, relief is afforded, but no definite assurance can be given the patient prior to operation. Failure is due chiefly to the improper selection of cases, and the limitation of the operation itself, which does not include enough of the nerves supplying the artery involved; the anatomical distribution of the vasomotor fibers of the vessels is segmental and they enter the sheath of the vessel at different levels rather than at the main trunk to follow the vessel to its final distribution. It has been demonstrated that lumbar sympathetic ganglionectomy with ramisectomy relieves instantly and permanently the vasomotor spasm that occurs in Raynaud's disease. Such relief is more pronounced in the lower extremities than that from similar treatment of the upper, and is due to the fact that the Royle operation or complete cervical sympathectomy, fails to include all of the gray rami to the brachial plexus. It is true that lumbar sympathetic ganglionectomy and ramisectomy have failed to relieve patients suffering from pain and intermittent claudication due to arteriosclerosis; however, it has relieved the symptoms in a selected group of cases of thrombo-angiitis obliterans with superimposed vasomotor spasm of the collaterals of the principal arteries and veins.

Ramisectomy, as suggested by Royle and Hunter, diminishes plastic tone. This point has been argued extensively, pro and con. Kuntz has shown that plastic tone is diminished after division of the gray rami communicantes. The assertion made by Royle and Hunter that ramisectomy is indicated in a selected group of cases and that it will diminish spasticity, has been greatly misinterpreted and exaggerated. It will not alter cerebral degeneration or improve a mentally deficient child suffering from Little's disease; neither will it improve cerebellar ataxia, athetosis, or the tremor associated with Parkinson's disease. Clinically, it is indicated if spasticity has failed to respond or has responded only partially to the numerous orthopedic measures that are being employed.

Sympathectomy and ramisectomy are used experimentally in many cases, such as bronchial asthma, pyloric spasm, spasticity of the colon, and arthritis. As yet, no definite deductions can be made from the results.

A. W. Adson, M.D.

MASTER SURGEONS OF AMERICA

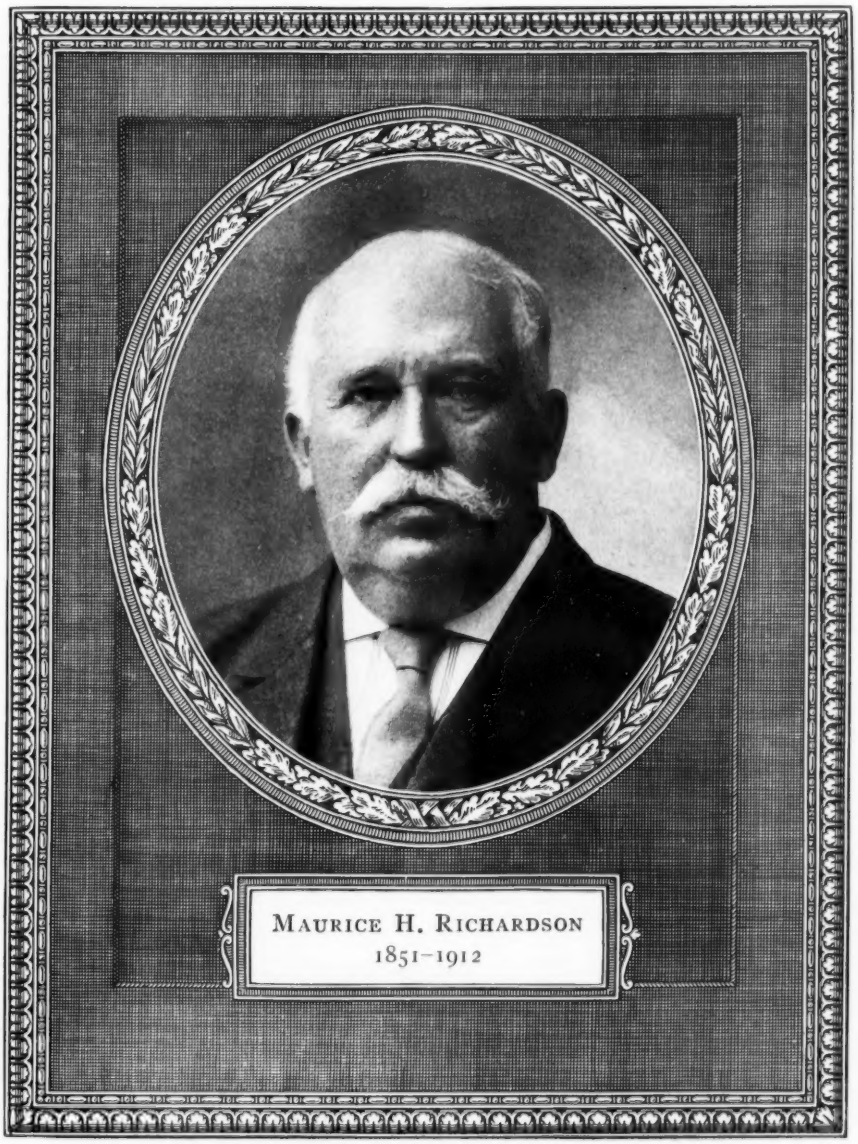
MAURICE HOWE RICHARDSON

MAURICE HOWE RICHARDSON was born at Athol, Massachusetts, December 31, 1851. He came from a long line of New England farmers of English descent, to whom this country is greatly indebted. He had his preliminary education in the public schools of Fitchburg, and later entered Harvard College, from which he was graduated with the class of 1873.

Like many young men of that day he taught school immediatey after leaving college, and fortunately for him his first experience was in the high school at Salem, Massachusetts, where he became acquainted with Dr. Edward B. Peirson, a most estimable gentleman and physician of high standing in the community. This was important for Dr. Richardson because he later married Dr. Peirson's daughter, a most admirable woman, and because Dr. Peirson undoubtedly had great influence in interesting him in the study of medicine, and took him into his office for a year before he entered the Harvard Medical School. Dr. Peirson was a fine type of general practitioner and the year spent with him gave Dr. Richardson an excellent background for his professional work.

From Dr. Peirson's office Dr. Richardson entered the Harvard Medical School as a second-year student and was graduated with the class of 1877. Soon after graduation he became a private assistant to the demonstrator of anatomy in that institution, the importance of which appointment evidently appealed to him, since he gave up his duties as surgical house officer at the Massachusetts General Hospital in order to accept the position. For many years he was intimately connected with the anatomical department; his interest and enthusiasm in it were unbounded; and he believed it was through this door that one should enter the practice of surgery rather than through the research laboratory, as is customary at the present time. He was the first physician in New England to limit his practice entirely to surgery. While he had not the advantages of the European clinics, like many of his time, he enjoyed the benefit of the traditions of those clinics as handed down through the elder Warren and Henry J. Bigelow, and through the close association of his colleagues, J. Collins Warren and Arthur T. Cabot, who had been clinical students in Europe.

Dr. Richardson was appointed to the staff of the Massachusetts General Hospital in 1881, and continued as an important and valuable member of that



MAURICE H. RICHARDSON
1851–1912

body. He also accepted the chair of clinical surgery at the Harvard Medical School in 1903, was made Moseley professor of surgery in 1907 and held both his hospital position and the professorship in the medical school until his death in 1912.

As a teacher, Dr. Richardson was a power in the class room. Late in the afternoon, a group of eager students might be seen crowding about him to witness his demonstrations of surgical anatomy. Interest was stimulated and the value of the anatomical demonstration impressed by the application of the anatomy demonstrated to some definite clinical problem. An incident of these demonstrations which never ceased to interest the students was his ability to draw on the blackboard with both hands at the same time. So contagious was his interest that the appointment of two students to perform the dissections necessary in the demonstrations caused enthusiastic and good natured rivalry among the members of the class. His characteristic good judgment in the selection of these students is demonstrated by the fact that many of them have become well known surgeons in various part of the country. He frequently came into the lecture room directly from his work, bringing the enthusiasm and exhilaration which always characterized him in the operating room. This natural transition gave the students a sense of the intimate relationship between the subject of his lecture and the practice of surgery. His varied experience and ready memory invariably offered him a fund of illustrations from which to draw one appropriate to the case in hand.

At the hospital Dr. Richardson's popularity and influence were even greater than in the school. Here he came into intimate contact with house officers and junior members of the staff, who felt the magnetism of his enthusiastic and friendly personality. One of the prominent characteristics of Dr. Richardson was his frankness in discussing his errors in diagnosis, technique, and judgment, an example which stimulated not only his assistants but also surgeons throughout the country toward the attainment of professional sincerity and frankness.

In addition to a large private practice and heavy hospital service, Dr. Richardson found time to write on a great variety of subjects. His earlier papers covered a wide field of general surgical problems, but later were confined largely to abdominal conditions. Many papers showed the influence of his great friend and admirer, Dr. Reginald H. Fitz, with whom he worked in close association both in his private work and in the hospital. There was always the rivalry which is present between medical and surgical men, but a most pleasant and stimulating one. To his monographs, written in earlier years, he added a book on surgery of the abdomen, which he never completed. Much of this volume was written between the hours of 5 and 8 in the morning, before his routine duties began.

Dr. Richardson's first work on the operative treatment of appendicitis was published in 1888. A piece of original work, based entirely upon his anatomical

knowledge, was the removal of a set of false teeth from the lower end of the œsophagus through the stomach. He published this paper in 1886. Three years later he performed the first successful cholecystostomy in New England. In 1898 he published his first case of total gastrectomy.

As an operator Dr. Richardson had few equals. Although of very strong physique and unusually large proportions, his delicacy of touch was marvelous and he was a master technician. He was noted as a skillful and rapid operator, with great regard for tissue. While many of us feel that Crile has taught us much about the careful handling of tissue, Dr. Richardson may be called a pioneer in this art. It is interesting to note that Dr. Richardson's delicacy of touch was so rare that he was able to write the Lord's Prayer on a ten cent piece.

When we consider that the surgeons of his day were pioneers in modern surgery, we can but marvel at their skill and foresight, for in spite of the thousands of articles written on supposed improvements in technique, their work still remains as the foundation of it all. A friend once asked me what original work Dr. Richardson had done. Most of us forget that the surgeons of his time were constantly doing original work. They had to build up the foundations of the present day surgery, and I believe we all agree that they built wisely. Dr. Richardson was one of the men of the generation bridging the period between the pre-antiseptic surgery and antiseptic and aseptic surgery, a period when every part of the body was thrown open to the surgeon by the employment of asepsis. This was a period when nearly every surgeon was obliged to employ his own methods and there was little standardization, as new technique for various operations was constantly being reported. It is a great tribute to the master surgeons of that period that their technique has stood the test of time, and while minor changes have been made in various procedures, the great bulk of them stand today as firm foundations of the present day surgery.

While Dr. Richardson was best known as a skillful operator, those who were close to him knew him as a brilliant diagnostician. While seemingly careless at times about the diagnosis, he always obtained by accurate observation, by remarkable ability to select the essential facts in a history, and by a highly developed sense of touch, sufficient information to enable him to make an accurate diagnosis. When one considers the modern elaborate methods of diagnosis, we who saw the brilliant results of Dr. Richardson and his contemporaries, obtained by accurate observation, a careful history, and well trained fingers, are inclined to believe that our present methods are hardly commensurate with the effort expended. His judgment and sense of proportion were unusual.

As a man Dr. Richardson had all the qualifications of a surgeon, great strength and vigor, yet with the delicacy of touch of a musician, which he was, and a personality which left little to be desired. He had a remarkable power of observation and a well trained mind, was sympathetic, enthusiastic with an

enthusiasm which was contagious, simple, frank, never assertive or bigoted; his whole being expressed that simplicity and frankness which endeared him to friends, patients, and colleagues. It was his honesty of purpose and frankness in his writings and discussions which made a great impression upon students, medical men with whom he came in contact, colleagues, and surgeons everywhere.

Dr. Richardson was a musician of no mean ability, and early in his career played the piano and cello. His love for the woods and the streams was that of the boy who had been brought up in the country and knew every trout brook for miles about.

Dr. Richardson lived in the time when the surgeons of Boston did much of their work in the homes of patients and in the smaller hospitals scattered over New England. To carry on a large practice in this way is expensive in time and strength, and although with the latter he was exceptionally well endowed, he was generously and whole heartedly unsparing of himself and his time. No patient was ever turned away because he or she could not afford to pay him. This type of work deprived Dr. Richardson to a very considerable extent, in the later years of his life, of the recreation which he found in music and out-of-door life.

We have then in Dr. Richardson all the qualities which go to make a master surgeon, one whose traditions are worthy to be handed down to the oncoming generations. He was a great teacher, not only because he was able to convey accurate knowledge and enthusiasm to the student, but because he had the ability to train younger men to carry on his work. He was a diagnostician of unusual ability and an operator of great skill. As a man he had the personality, the honesty of purpose, the simplicity, and frankness which had a great influence upon students and the profession in general.

D. F. Jones.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha

THE SEVENTEEN BOOKS OF ORIBASIUS OF SARDIS

FOUR names stand out above all others as representing the best there was in the medicine and surgery of the Byzantine period. Oribasius, of the fourth century A.D.; Alexander of Tralles, and Aetius of Amida of the sixth century; and Paul, of Aegina, of the seventh century. Oribasius of Sardis or Pergamus was the earliest of the group. He was born in 325 A.D., in Pergamus, a city of Mysia, situated on the shore of the Aegean Sea and noted as the birthplace of his great medical predecessor Claudius Galen, one of the greatest physicians of all time. He obtained a good early education at home, but not being content with what he could obtain in Pergamus, went to Alexandria and there studied under the learned Zeno, of Cyprus. As Oribasius was of noble birth and also gained considerable reputation as a brilliant student he came under the notice of Julian whom he met after he had completed his education at Alexandria and had gone to Athens. Being rather prominent and somewhat powerful politically he helped Julian the Apostate to gain the throne of the Cæsars and in return was appointed Quæstor of Constantinople. Julian's reign was short, lasting only from 361 to 363, but during this time Oribasius did most of his writing. At Julian's request he wrote a compendium of the works of Galen which has been lost. He also wrote the "Collectanea Medicinalia" which consisted of 70 books. Of these, 25 have been preserved, but the volume here illustrated contains but 17.

Oribasius' prominence, depending as it did upon the favor of the emperor, was short lived. Julian planned and executed a campaign into Persia and Oribasius accompanied him as physician in ordinary, thus receiving some experience in the surgery of war. Julian, however, was wounded and Oribasius was unable to cure him. After Julian's death the new authorities promptly, as was the custom, took away Oribasius' property and banished him among the barbarians, probably the Goths. He rapidly attained a great reputation as a physician and evidently became so prominent that his own country desired his return for shortly afterward he was brought back to Constantinople where he lived until his death in 403 A.D.

Though after his return to Byzantium Oribasius wrote a few small treatises both for the medical and lay public, his greatest work was the Ἰατρικαὶ συναγωγαι or Medical Collection. It was written in Greek; but shortly after it was printed in the original, Latin became the language of medicine and it was naturally translated into that tongue. The volume illustrated here prints 17 of the original 70 books, which the translator, John Baptist Rasarius, states are all that are extant. The books are not in order for those from the fifteenth to the twenty-fourth are missing and the volume includes the twenty-fourth and twenty-fifth books. As the title page shows, it was printed in Paris by Bernard Turrisanus at the Aldine press and bears the famous Aldine anchor and dolphin.

Oribasius was a compiler and follower of his predecessors in medicine and does not pretend to be anything else. He had evidently read carefully the works of these older men and his object in writing the treatise was to explain their ideas in simple terms. In every instance he gives credit to his authority and his list is too long to mention here, but his constant reference to Galen, Antyllus and Rufus of Ephesus are worthy of mention. The books or chapters most interesting to the surgeon are the sixth, seventh, twenty-fourth and twenty-fifth. The sixth is devoted to hygiene and physical therapy, including exercise and massage. In the seventh, blood-letting is discussed and the ideas of Antyllus and Galen as to the indications and sites for venesection are carefully gone into. Antyllus' operation for aneurysm is described. The twenty-fourth and twenty-fifth books are devoted to anatomy, the twenty-fourth to the anatomy of Galen and the twenty-fifth to that of Rufus of Ephesus.

Throughout his works, Oribasius seems to be approaching his subject with a judicial and unbiased mind. He is endeavoring to give the ideas of the authorities as best he may and letting his reader form his own conclusions rather than forcing his personal opinions on him. Consequently one feels that in this work he is getting a true insight into the thoughts and opinions of the ancient surgeons through the medium of an educated and clear thinking man and it is not difficult to understand why it was so frequently included in the Beneventan manuscripts.

ORIBASII SARDIANI COLLECTORUM Medicinalium,

LIBRI XVII,

QVI EX MAGNO SEPTVAGINTA librorum volumine ad noſtram ætatem ſoli peruenerunt.

Ioanne Baptiſta Raſario, medico, Nouarienſi, interprete.

PARISIIS.
Apud Bernardinum Turriſanum, via Iacobæa, ſub officina Aldina.
1555.

REVIEWS OF NEW BOOKS

THE official history of the A. E. F. neuropsychiatric organization is still in preparation. Dr. Fenton[1] presents a book which for all practical purposes gives a thorough and most interesting account of the system of handling the neuroses which was developed in our army and a detailed account of the work of Base Hospital 117. Due credit is given to the vision and ability of Dr. Thomas W. Salmon who developed this organization. Thanks to the foresight and efficiency of the author, data were preserved which made possible further post-war studies of the former patients of Base 117. The National Committee for Mental Hygiene sponsored two follow-up studies, one in 1919–20 and another in 1924–25. The present volume offers the results of these intensive statistical studies, preceded by a thorough survey of the original material and followed by an outline of the problem of the neuroses with suggestions as to wiser methods of handling these cases in the future.

The volume is replete with tables but nevertheless makes easy reading. Though a short book, it represents a monumental amount of work done. All conclusions are weighed most carefully. It is possible here to give but a few examples: Among the patients was a significantly greater proportion of officers than men as compared to the normal ratio for troops; there were more volunteers admitted than conscripts; the infantry, which had the highest percentage of killed in action were not the highest among the psychoneurotics; there was a low proportion of patients who had come from agricultural pursuits; concussion, gas and anxiety types, the true war neuroses, did better in readaptation than the more constitutional types, neurasthenia, hysteria, or psychasthenia; the clerical and professional groups are making the best readjustments.

The title *Shell Shock* is somewhat surprising both because the author has no such limited conception of the problem as this might imply and in view of the statement on page 80, ". . . the term *shell shock* was ruled out as an official diagnosis early in the history of the A. E. F."

According to Salmon, the World War was the first in which the functional nervous diseases constituted a major medicomilitary problem. The present volume is a fundamental contribution to military medicine and its subsequent responsibilities.

JOHN FAVILL.

MONTAGUE'S book on hemorrhoids[2] is a good book for the general practitioner who does occasional hemorrhoid operations. The procedures of operation, the preliminary treatment, and the after treatment which the author advocates are good, sane, common sense methods. These procedures are described in sufficient detail to make them understandable. RALPH BOERNE BETTMAN.

A VOLUME[3] of 126 pages on applied refraction, divided into 24 chapters with an index and several illustrations of recent equipment, contains the attributes and defects peculiar to all books detailing an author's personal views on any subject.

It is not for the beginner and details nothing of the science of refraction, but in it the author attempts an exposition of the art. It is his purpose not to consider controversial matters. Where doubt or differences exist the author gives his own opinion; hence, few references are given and few authorities quoted. The first chapters are devoted to a description of the refraction room, equipment such as chair, trial frame, case, test chart, ophthalmometer, cross cylinder, and illumination. Much of this is good, especially the quiet surroundings and equanimity of patient and doctor, but ophthalmic paraphernalia housed in a bird cage perched on a pole, accoutered and buttressed with sliding doors, dials, discs, and control knobs, will never appeal to the more conservative. The old-fashioned test chart is not to be discarded so easily nor replaced in the affections of the old artist who for years has worked out to a nicety many difficult cases with the less complicated but not so all-inclusive an instrument as the genophthalmic visual test apparatus. It is true, perhaps, that vision should be recorded in decimal fractions, instead of the old system wherein the numerator represents the distance of the patient from the test chart, to comply with the modern method of recording in all scientific work.

The author is in favor of cycloplegia in all cases and at all ages. The fear of glaucoma and the feeling that accommodation is being physiologically abolished, lead many to refrain from the use of a cycloplegic after middle life when the suppression of that accommodation, at the time of refraction, which does remain may very well be and often is the key to the solution of some symptoms of ametropia. The teachings of Duane and Jackson are monumental in this too often disputed field. Nor is the fact that the cycloplegic and post-cycloplegic tests differ occasionally an argument against the dilatation of the pupil, with the greater facility of fundus study, temporary arrest of accommodation with the further therapeutic measure of retinal and choroidal decongestion. The very foundation of good refraction is cycoplegia. The author's treatment of cycloplegic and post-cycloplegic refraction is altogether too complicated and too time-consuming. The chapter on the non-cycloplegic refraction is a contradiction of

[1] SHELL SHOCK AND ITS AFTERMATH. By Norman Fenton, Ph.D. St. Louis: The C. V. Mosby Co., 1926.

[2] THE MODERN TREATMENT OF HEMORRHOIDS. By Joseph Franklin Montague, M.D., F.A.C.S. Foreword by Harlow Brooks, M.D., F.A.C.S. Philadelphia: J. B. Lippincott Co., 1926.

[3] APPLIED REFRACTION. By Homer Erastus Smith, M.D. New York: William Wood and Company, 1927.

all the good attained by his arguments for a cycloplegia.

The anomalies of accommodation found at the post-cycloplegic test are well described by the author in the eighteenth chapter, but his classification and exposition of the relationship of them to visual acuity, refractive error, muscle imbalance, position of work, and convergence power, is inconsistent. Here, as in all else in refractive work, the paramount issue is the individuality of the patient. In the same manner the author's treatment of the changes of refraction during advancing years cannot be so mathematically mapped out. The first cycle of 24 years concerns itself with growth and development with attendant changes in refraction. The second 24 years cannot be called one of stasis just because changes are not so marked as in the first and last quarter century of an ordinary life. Nor is it possible to expect eyes in the third quarter to manifest evidences of refractive change so uniform and consistent as to be prophesied and charted with such assurance as the author details. Very few eyes conform to type. While the changes through the years may be great or small, spherical or astigmatic, the changes are there; and they need ever constant correction if eyes are to remain healthy and retain perfect functioning power.

The closing chapters are concerned with the mechanics of lenses, their manufacture and adjustment for use in spectacles; and a chapter is devoted to prisms and the correction of muscular anomalies.

VIRGIL WESCOTT.

DOCTOR LENK'S splendid work on X-ray therapy[1] has proven so popular that it has gone through several editions and has been translated into five languages. This is abundant evidence of its value to the profession and a sufficient reason for this English translation. With a foreword by Holzknecht the book is in index form and the subject is presented, not primarily to the specialist in X-ray therapy, but to the general practitioner, although the roentgenologist too will find much practical help in the treatment formulæ which are given under each of the conditions described. The X-ray dosages are given in terms of Holzknecht units and are entirely practical and easy to apply. The various lesions amenable to X-ray radiation are arranged alphabetically and the great number of diseases specified in detail will be a surprise to many. This work is the result of an unusually large clinical experience at the University of Vienna and is a reliable guide to the practical application of X-ray in the treatment of disease.

EDWARD S. BLAINE.

IN the eighth edition of the *Manual of Bacteriology*,[2] by Muir and Ritchie, Professor Muir has had the assistance of Dr. Carl H. Browning, Gardner professor of bacteriology, University of Glasgow, and Dr. Thomas J. Mackie, successor to the late Dr. James Ritchie as Irvine professor of bacteriology, University of Edinburgh. This textbook being designed primarily for students and practitioners of medicine, only the pathogenic bacteria, protozoa and fungi are considered at any length. The method of presenting the subject is the same as in previous editions with but minor changes.

Since the seventh edition, which was published in 1919, the science of bacteriology has been marked not so much by outstanding discoveries as by a steady growth in our knowledge and improvement in technique. The advances have been comprehensively incorporated in this latest edition by extensive additions and alterations. Portions shown by time to be less important have been condensed or put in smaller type with the result that the work is but slightly larger than the previous edition. The effort to maintain the size of the volume has led to the use of poor spacing, too small type, and crowded pages. This is a real objection for the student must intensively study a textbook which accordingly should be capable of being read with ease. The quality and extent of the contents of this book warrant a larger volume.

The older nomenclature of bacteria has been employed followed by that of the Society of American Bacteriologists. Both the older and the Society of American Bacteriologists' classification and nomenclature are described in the text. The bibliography has been brought up to date by chapters at the end of the book.

A. A. DAY.

THE fourth edition of the standard French textbook on local anæsthesia is just off the press.[3] The widespread surgical activities of Victor Pauchet furnish plenty of material for his associates to develop and practice methods of local anæsthesia. The material is handled in such a way that methods of anæsthesia are separated to a great extent from their regional application and from the description of typical operations. Repetitions are consequently unavoidable and the references from one place to another are not always accurate. The value of the book would be greatly enhanced if the results and the untoward symptoms of these methods were mentioned. Some of the statements in the book are open to discussion; for instance, that stovain is a "marvelous" drug in spinal anæsthesia, the large amount of adrenalin to be added to the novocain solution, and particularly the strong advocation of paravertebral injections. The illustrations are diagrammatic, but serve their purpose well. Their origin is not always stated, although due credit is given to most of the recent French workers. The succession of editions proves the need of such a book, which adds to the spread and development of new and reliable anæsthetic procedures in the French literature.

G. DE TAKATS, M.D.

[1] INDEX AND HANDBOOK OF X-RAY THERAPY. By Robert Lenk. Foreword by Professor Holzknecht. Translated by T. I. Candy, M.B., B.Ch., D.M.R.E. New York: Oxford University Press, 1926.

[2] MANUAL OF BACTERIOLOGY. By Robert Muir, M.A., M.D., and the late James Ritchie, M.A., M.D. 8th ed. rev. New York: Oxford University Press, 1927.

[3] L'ANESTHESIE REGIONALE. By V. Pauchet, P. Sourdat, G. Labat, R. de Butler d'Ormont. 4th ed. Paris: G. Doin & Cie, 1927.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

WALTER W. CHIPMAN, Montreal, *President* GEORGE D. STEWART, New York, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*

DETROIT COMMITTEE ON ARRANGEMENTS

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IRA G. DOWNER			

Sub-Committee on Eye, Ear, Nose and Throat Surgery

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COMPLETE PROGRAM FOR THE CLINICAL CONGRESS IN DETROIT

PLANS for the seventeenth annual Clinical Congress of the American College of Surgeons, to be held in Detroit, October 3 to 7, 1927, are practically complete. Under the leadership of a strong and representative committee of Detroit and Ann Arbor surgeons, a program of clinics and demonstrations that will adequately represent the clinical activities in the hospitals of Detroit and Ann Arbor, the medical school of the State University at Ann Arbor, and the Detroit College of Medicine and Surgery has been prepared and is published in the following pages. The program is to be further revised and amplified during the weeks preceding the Congress. Clinics and demonstrations will be conducted during the mornings and afternoons of each of the four days, Tuesday to Friday inclusive. Members of the faculty of the medical school of the State University are making special plans to entertain the visiting surgeons on each of the four days.

The actual program of the Congress is to be issued daily during the session, giving in complete detail a description of the clinics and demonstrations at the several hospitals and medical schools. This program will be issued in the form of bulletins posted each afternoon at headquarters for the following day's clinics. A printed program will be issued each morning. The clinical program for Tuesday will be posted during Monday afternoon and reservations for tickets for Tuesday's clinics may be filed late that afternoon.

An important feature of the clinical program will be a special series of clinical demonstrations, illustrative of diagnosis and operative and postoperative treatment of surgical conditions, to be held at Orchestra Hall in the afternoons and at the Statler Hotel in the mornings. The details will be found in the following pages.

On Friday afternoon in Orchestra Hall there will be a symposium on traumatic surgery. Much interest will center in this symposium as leaders of industry, labor, the indemnity companies, and the medical profession will here combine for consideration of a subject of mutual interest. These four groups have all a direct interest in the efficient care of the injured, and means by which they may co-operate to improve the practice of traumatic surgery will be discussed by the leaders from all standpoints. Technical surgical details will not form a part of this program. A report will be presented by the Board on Traumatic Surgery on its activities of the present year, and also an outline of its program for the coming year.

General headquarters for the Congress will be established at the Book-Cadillac and Statler Hotels, both located on Washington Boulevard. At the former hotel will be found the registration and ticket bureaus, bulletin boards, exhibits,

etc., while the large public rooms at the latter hotel will be utilized for clinical demonstrations and various scientific meetings.

There will be on exhibition at headquarters during the Congress a replica of the Lister exhibit in the Wellcome Historical Medical Museum in London, which has been presented to the College by Mr. Henry S. Wellcome.

The annual meeting of the Fellows of the College for the election of officers and the reception of reports of officers and committees will be held in Orchestra Hall on Thursday afternoon at 2 o'clock.

EVENING MEETINGS

The Executive Committee has prepared programs for evening sessions on each of the five days of the Congress. These will be held in Orchestra Hall, a new and beautiful auditorium located on Woodward Avenue convenient to the hotels.

On Monday evening, at the Presidential Meeting, the first formal session of the Congress, the President-Elect, Dr. George David Stewart of New York, will be inaugurated and deliver the annual address. On the same evening Sir John Bland-Sutton of London will deliver the John B. Murphy oration in surgery.

The meeting on Tuesday evening will take the form of a memorial to Lord Lister, this being the year of the Lister centennial. The principal speaker will be Dr. W. W. Keen of Philadelphia, the Nestor of American surgery, who was one of the first on this continent to use Lister's methods.

The annual convocation will be held on Friday evening, on which occasion the 1927 class of candidates for fellowship in the College will be received.

ANNUAL HOSPITAL CONFERENCE

The tenth annual Hospital Standardization Conference of the American College of Surgeons opens on Monday, October 3, with morning and afternoon sessions in Orchestra Hall. During the following three days there will be morning and afternoon sessions at the Statler Hotel. A most interesting program of addresses, round table conferences, and general discussions, dealing with everyday problems of practical interest, will be presented.

Special demonstrations in various phases of hospital administration will be given in the Detroit and Ann Arbor hospitals on Wednesday and Thursday afternoons. On Wednesday morning there will be a most interesting symposium on the standardization of special departments for eye, ear, nose and throat patients in the general hospital.

The program throughout will be of particular interest to surgeons and physicians, superintendents, trustees, nurses, and hospital personnel generally, and a cordial invitation is extended to all persons interested in hospital work to attend.

An unusual opportunity is afforded hospital people this year to attend three national hospital meetings in succession, beginning with the Hospital Conference of the American College of Surgeons at Detroit, October 3–6, leaving Detroit on October 6, spending October 7 visiting Chicago hospitals, and arriving in Minneapolis the morning of October 8 to attend the American Protestant Hospital Association and the American Hospital Association meetings, the week of October 10.

SPECIAL PROGRAM ON SURGERY OF THE EYE, EAR, NOSE, AND THROAT

The sub-committee in charge of the section on surgery of the eye, ear, nose and throat has prepared a comprehensive and attractive program of clinics and demonstrations that will be of real interest to surgeons engaged in the practice of ophthalmology and otolaryngology.

The program includes a series of clinical demonstrations on Tuesday, Thursday and Friday forenoons, with a special session on Wednesday forenoon devoted to a symposium dealing with the standardization of the eye, ear, nose, and throat departments in general hospitals. All of these sessions will be held at the Statler Hotel.

At the Tuesday morning session papers comprising a symposium on brain abscess will be presented; at the Thursday morning session, a symposium on plastic surgery; and on Friday morning a symposium dealing with various aspects of the treatment of eye injuries in industry.

During the afternoons of each of the four days, Tuesday to Friday inclusive, the clinicians of Detroit and Ann Arbor will entertain the visiting surgeons at clinics in the several hospitals. A comprehensive and varied program of operative clinics and demonstrations has been prepared covering all phases of clinical work in these special fields.

REDUCED RAILWAY FARES—CERTIFICATE PLAN

The railways of the United States and Canada have authorized reduced fares on account of the Detroit session of the Clinical Congress, so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is

necessary to pay the full one-way fare to Detroit, procuring from the ticket agent when purchasing ticket, a "convention certificate" which certificate is to be deposited at headquarters for the visé of a special agent of the railways. Upon presentation of viséed certificate to the ticket agent in Detroit not later than October 11 a ticket for the return journey by the same route as traveled to Detroit may be purchased at one-half the regular one-way fare.

In the eastern, central, and southern states and eastern provinces of Canada tickets may be purchased between September 29 and October 5; in southwestern and western states between September 28 and October 4, and in the far western states and western provinces of Canada between September 24 and 30. The return journey from Detroit must be begun not later than October 11.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stopovers on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Detroit, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséed by a special railroad agent in Detroit during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Detroit and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 11.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30, with a final return limit of October 31. The summer excursion fare is considerably lower than the convention fare of one and one-half fares for the round trip, but is available only in the Pacific Coast states and British Columbia. Tickets sold at summer excursion rates permit traveling to Detroit via one direct route and returning via another direct route, with liberal stop-over privileges.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Detroit session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Therefore those who wish to attend must register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets, which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic is limited to the capacity of the room assigned to that clinic.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card, which is nontransferable, must be presented to secure clinic tickets and admission to the evening meetings.

DETROIT HOTELS AND THEIR RATES

There are ample first-class hotel accommodations in Detroit for all who wish to attend, most of the hotels being located within short walking distance of the headquarters hotels.

	Minimum Rates with Bath	
	Single Room	Double Room
Barlum, Cadillac Sq. at Bates	$2.50	$4.00
Book-Cadillac, Washington and Michigan	4.00	6.00
Carlton-Plaza, 2931 John R. St.	2.50	4.00
Clifford, Clifford and Duffield	2.50	4.00
Detroit-Leland, Cass at Bagley	3.50	5.50
Fairbairn, Columbia and John R.	2.50	4.00
Fort Shelby, Lafayette and First	3.00	4.50
Fort Wayne, Cass and Temple	2.50	3.50
Gotham, John R. and Orchestra Pl.	2.50	3.50
Imperial, 26 Peterboro St.	3.00	5.00
Madison-Lenox, Madison Ave.	2.50	3.50
Norton, Jefferson and Griswold	2.75	4.50
Palmetto, John R. and Hancock	3.50	5.00
Royal Palms, 2305 Park Ave.	3.50	5.00
Savoy, Adelaide and Woodward	2.50	4.00
Statler, Grand Circus Park	3.00	5.00
Stevenson, 46 Davenport	2.50	4.00
Strathmore, 70 W. Alexandrine	2.00	3.50
Tuller, Grand Circus Park	2.50	5.00
Webster Hall, 111 Putnam Ave.	3.00	....

PROGRAM FOR EVENING MEETINGS

IN ORCHESTRA HALL AT 8:15 P.M.

Presidential Meeting—Monday, October 3

Address of Welcome: ALEXANDER W. BLAIN, M.D., Chairman of Committee on Arrangements.
Address of Retiring President: WALTER W. CHIPMAN, M.D., F.R.C.S. (Edin.), Montreal.
Introduction of Foreign Guests.
Inaugural Address: GEORGE DAVID STEWART, M.D., New York.
The John B. Murphy Oration in Surgery: SIR JOHN BLAND-SUTTON, Bt., LL.D., M.D., F.R.C.S., London.

Lister Centenary—Tuesday, October 4

Presentation of the Replica of the Lister Exhibit in the Wellcome Historical Medical Museum, London. HENRY S. WELLCOME, Esq., London.
Presentation of the Lister Tablet to the American College of Surgeons. HORACE G. WETHERILL, M.D., Monterey, California, in behalf of the Western Surgical Association.
Introduction of JOHN STEWART, C.B.E., M.B., C.M., LL.D., Halifax, Nova Scotia, who was an assistant to Lord Lister.
Lister Oration: WILLIAM WILLIAMS KEEN, M.D., Ph.D., LL.D., F.R.C.S. (Eng., Edin., Ire.), Philadelphia.
Lister's Influence on Present Day Surgery: WILLIAM J. MAYO, M.D., Rochester, Minnesota.
Remarks by SIR JOHN BLAND-SUTTON, Bt., LL.D., M.D., F.R.C.S., London, England.

Wednesday, October 5

HOWARD C. TAYLOR, M.D., New York: Radical Operation for Cancer of the Uterus.
PROFESSOR GUSTAF E. ESSEN-MÖLLER, Lund, Sweden: One Thousand Laparotomies for Myoma Uteri.
PROFESSOR S. A. GAMMELTOFT, Copenhagen, Denmark: Heart and Pregnancy.
JOHN OSBORN POLAK, M.D., Brooklyn: Fibroids in Pregnancy and Labor.

Thursday, October 6

FRANK H. LAHEY, M.D., Boston: Surgery of Gastric and Duodenal Ulcers.
ROBERT GORDON CRAIG, M.B., Ch.M., Sydney, Australia: Hydatid Disease of the Kidney.
GEORGE P. MULLER, M.D., Philadelphia: Suppurative Diseases of the Chest.

Convocation—Friday, October 7

Conferring of Honorary Fellowships.
Presentation of Candidates for Fellowship.
Presidential Address: GEORGE DAVID STEWART, M.D., New York.
Fellowship Address.

CLINICAL DEMONSTRATIONS IN SURGERY

Tuesday 9:30 a.m.—Statler Hotel

DAVID H. BALLON, M.D., C.M., Montreal: Diagnostic Value of Lipiodol in Bronchopulmonary and Pleural Lesions.

SAMUEL IGLAUER, M.D., Cincinnati: The Advantages of Brominized Oil in Bronchography in Tuberculous Patients.

HUBERT A. ROYSTER, M.D., Raleigh, North Carolina: Appendicitis.

2:30 p.m.—Orchestra Hall

GEORGE W. CRILE, M.D., Cleveland: Cases of Gall-Bladder Disease.

EUGENE H. POOL, M.D., New York: Lesions of the Large Intestine.

HUGH H. YOUNG, M.D., Baltimore: Progress of Antisepsis in Urology.

Wednesday, 9:30 a.m.—Statler Hotel

ELMER HESS, M.D., Erie, Pennsylvania: Tuberculosis of the Kidney.

LEONARD G. ROWNTREE, M.D., Rochester, Minnesota: Cardiovascular Complications.

C. JEFF MILLER, M.D., New Orleans: Management of Chronic Endocervicitis.

2:30 p.m.—Orchestra Hall

J. M. T. FINNEY, M.D., Baltimore: Speaking of Operations.

ERNST A. SOMMER, M.D., Portland, Oregon: Treatment of Acute Traumatic Joints.

JOHN B. DEAVER, M.D., Philadelphia: Ulcers of the Stomach.

Thursday 9:30 a.m.—Statler Hotel

LILIAN K. P. FARRAR, M.D., New York: Carcinoma of the Cervix and Application of Radium.

BARTON COOKE HIRST, M.D., Philadelphia: Different Types of Cæsarean Section.

VILRAY P. BLAIR, M.D., St. Louis: Ankylosis of the Jaw; Correction of the External Appearance, as Well as Ankylosis.

ROBERT S. CATHCART, M.D., Charleston, South Carolina: Massive Sarcoma of the Breast.

CANCER SYMPOSIUM

Thursday 3:00 p.m.—Orchestra Hall

Report of Progress and of Prospect: ROBERT B. GREENOUGH, M.D., Boston, Chairman of the Committee on the Treatment of Malignant Diseases with Radium and X-Ray.

The Lead Treatment of Cancer: HENRY J. ULLMANN, M.D., Santa Barbara, California.

Report on the Results of High Voltage X-Ray Treatment in Cancer: WILLIAM A. EVANS, M.D., Detroit.

The Use of Radium in the Treatment of Uterine Pathology: IRVIN ABELL, M.D., Louisville.

Histological Estimation of the Malignancy of Tumors: A. COMPTON BRODERS, M.D., Rochester, Minnesota.

Analysis Report: GEORGE A. SOPER, Ph.D., New York, Managing Director, American Society for the Control of Cancer.

SURGERY OF THE EYE, EAR, NOSE, THROAT AND MOUTH

Tuesday, 9:30 a.m.—Statler Hotel—Don M. Campbell, M.D., Chairman

Symposium: Brain Abscess and Tumor.

PROFESSOR DR. G. ALEXANDER, Vienna, Austria: Choked Labyrinth and Its Importance in Diagnosis and Indications in Brain Tumor.

JOSEPH C. BECK, M.D., Chicago: Brain Abscess and Tumor from the Standpoint of the Otologist and Rhinologist.

ALFRED W. ADSON, M.D., Rochester, Minnesota: Brain Abscess and Tumor from the Standpoint of the Neurological Surgeon.

W. I. LILLIE, M.D., Rochester, Minnesota: Views of Importance of Eye-Ground Examination and Fields of Vision.

Discussion opened by J. MILTON ROBB, M.D., Detroit.

Wednesday, 9:30 a.m.—Statler Hotel—George E. Frothingham, M.D., Chairman

Symposium: Standardization of Special Departments for Eye, Ear, Nose, and Throat Patients in General Hospitals. See detailed program under Hospital Conference.

Thursday, 9:30 a.m.—Statler Hotel—Burt R. Shurly, M.D., Chairman

Symposium: Plastic Surgery of the Face.

VILRAY P. BLAIR, M.D., St. Louis: Plastic Surgery of the Face.

Discussion by WALTER R. PARKER, M.D., Detroit, and FERRIS SMITH, M.D., Grand Rapids.

EDMUND B. SPAETH, M.D., Philadelphia: The Use of Fascia and Cartilage in Ophthalmic Plastic Surgery.

Discussion by HARRY GRADLE, M.D., Chicago.

JOHN M. WHEELER, M.D., New York: Plastic Repair of Orbit and Eyelid.

C. D. PARFITT, M.D., Gravenhurst, Ontario: Tuberculosis of the Larynx.

Discussion opened by GUY H. MCFALL, M.D., Detroit.

Friday, 9:30 a.m.—Statler Hotel—Walter R. Parker, M.D., Chairman

Symposium: Industrial Eye Surgery.

SIDNEY WALKER, M.D., Chicago: Aftermath of 250 Intra-Ocular Steel Cases.

F. D. GULLIVER, M.D., New York.

PLINN F. MORSE, M.D., Detroit.

DON M. CAMPBELL, M.D., Detroit.

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, UROLOGY, ORTHOPEDICS, ETC.

UNIVERSITY HOSPITAL

(Ann Arbor)

Tuesday

REUBEN PETERSON—10. Hysterectomy for fibroid; operation for ovarian cyst.

HUGH CABOT—10. Nephrectomy for tuberculosis; suprapubic prostatectomy; litholapaxy for stone in bladder.

F. A. COLLER—10. Subtotal thyroidectomy for exophthalmic goiter; resection of stomach for cancer; radical operation for cancer of breast.

MAX PEET—10. Section of sensory root gasserian ganglion; removal of cerebellar tumor; removal of spinal cord tumor.

CARL E. BADGLEY—10. Ununited fracture of neck of femur; extra-articular fusion of hip for tuberculosis; Dunn's operation for calcaneous foot.

CARL W. EBERBACH—10. Subtotal thyroidectomy for adenomatous goiter; nephrectomy for tuberculosis; pyelotomy for renal calculus.

JOHN ALEXANDER—10. Extrapleural thoracoplasty for pulmonary tuberculosis; phrenicectomy for pulmonary tuberculosis; drainage of abscess of lung.

VERNON HART—10. Ober's operation for club foot; Hoke's operation for club foot; arthrodesis of knee for tuberculosis.

ALDRED S. WARTHIN—10. Pathological conference.

EDWARD CATHCART—1:30. Suprapubic drainage of bladder (first stage prostatectomy); epididymectomy for tuberculosis; endothermy for bladder tumor.

P. M. HICKEY—1:30. Dry clinic: Diagnosis of bone tumor.

E. A. POHLE—2:15. Dry clinic: Use and abuse of ultraviolet rays.

C. D. CAMP—3. Dry clinic: The rôle of the neuropsychiatrist in avoiding unnecessary operations.

Wednesday

REUBEN PETERSON—10. Hysterectomy for pelvic inflammation; abdominal sterilization.

HUGH CABOT—10. Cholecystectomy with cholelithiasis; cholecystduodenostomy for biliary obstruction; appendectomy.

F. A. COLLER—10. Subtotal thyroidectomy for toxic adenomatous goiter; gastro-enterostomy for duodenal ulcer; operation for prolapse of rectum.

MAX PEET—10. Chordotomy for intractable pain of cancer; cerebral tumor; section of sensory root of gasserian ganglion.

CARL E. BADGLEY—10. Transplantation of tensor fascia femoris for poliomyelitis; open reduction of slipped femoral epiphysis; operation for ununited fracture.

ALDRED S. WARTHIN—10. Pathological conference.

CARL W. EBERBACH—10. Suprapubic prostatectomy; urethroplasty for urinary incontinence; ureterotomy for stone.

JOHN ALEXANDER—10. Thoracoplasty for chronic empyema; phrenicectomy for pulmonary tuberculosis.

EDWARD CATHCART—10. Suprapubic prostatectomy; orchiopexy for undescended testis.

A. S. WARTHIN—1:30. Dry clinic: Pathology of goiter.

G. CARL HUBER—2:15. Dry clinic: Development of kidney.

VERNON HART—1:30. Arthrodesis of knee for tuberculosis; tendon transplantation for poliomyelitis; arthrodesis of shoulder for tuberculosis.

Thursday

REUBEN PETERSON—10. Repair of relaxed vaginal outlet; repair of complete perineal tear.

HUGH CABOT—10. Appendectomy; suprapubic prostatectomy; nephrectomy for tumor; ureterocolostomy for exstrophy.

F. A. COLLER—10. Cholecystectomy for cholecystitis; colostomy for cancer of rectum; subtotal thyroidectomy for adenomatous goiter.

MAX PEET—10. Section of sensory root of gasserian ganglion; operation for cerebellar tumor.

CARL E. BADGLEY—10. Synovectomy for chronic infectious arthritis; Hibbs' operation for fusion of spine; arthrodesis of hip for tuberculosis.

CARL W. EBERBACH—10. Subtotal thyroidectomy for toxic adenomatous goiter; radical cure of chronic osteomyelitis; pyelotomy for renal calculus.

JOHN ALEXANDER—10. Extrapleural thoracoplasty for tuberculosis; extrapleural pneumolysis.

VERNON HART—10. Tendon transplantation for poliomyelitis; arthrodesis of ankle for poliomyelitis; transplantation of fibula for loss of substance in tibia.

UDO J. WILE—1:30. Dry clinic: The pre-operative treatment of syphilis in surgical cases.

P. M. HICKEY—2:15. Dry clinic: Graham's method of diagnosis of gall bladder lesions.

L. H. NEWBURGH and HUGH CABOT—3. Dry clinic: Nephritis and renal infections.

EDWARD CATHCART—1:30. Diverticulectomy for diverticulum of bladder; excision of bladder tumor; suprapubic prostatectomy.

HERMAN KIEFER HOSPITAL

Tuesday

EARL W. MAY—9. Hyperplasia of thymus in newborn.

E. J. O'BRIEN and G. C. PENBERTHY—10. Thoracoplasty, surgery of phrenic nerve, operations and demonstration of cases.

L. REYNOLDS—10. X-ray demonstration.

Wednesday

RUSSEL ALLES—9. Blood transfusion.

E. J. O'BRIEN and G. C. PENBERTHY—10. Thoracoplasty, surgery of phrenic nerve, operations and demonstration of cases.

L. REYNOLDS—10. X-ray demonstration.

Thursday

C. C. BIRKELO—9. Demonstration: Tuberculous enteritis.

G. C. PENBERTHY—9. Empyema.

W. L. SEELEY and staff—9. Obstetrical ward walk.

Friday

E. J. O'BRIEN and G. C. PENBERTHY—9. Thoracoplasty, surgery of phrenic nerve, operations and demonstration of cases.

L. REYNOLDS—9. X-ray demonstration.

HARPER HOSPITAL

Tuesday

MAX BALLIN and associates—9. Surgical clinic.
C. W. HALLIDAY and C. G. JENNINGS—9. Goiter clinic: Incidence of goiter, medical aspects of goiter.
GEORGE KAMPERMAN—9. Gynecological operations.
WARD SEELEY—9. Demonstration: Management of pelvic inflammatory disease.
F. H. COLE—9. Demonstration: Methods of diagnosis of ureteral obstruction.
W. K. REXFORD—9. Demonstration: Bladder tumors.
R. A. MACARTHUR—9. Demonstration: Treatment of epididymitis.
H. C. SALTZSTEIN and TRIAN LEUCEUTIA—9. Cancer clinic.
A. D. LAFERTE—9. Open treatment of fractures.
F. C. KIDNER—9. Cases of enchondromata.
R. V. FUNSTON—9. Orthopedic results.
HAROLD HENDERSON—9. Puerperal sepsis.
O. C. FOSTER—9. Fetal mortality causes.
C. L. STRAITH—9. Oral surgery clinic, operations and demonstration of cases.
J. J. TOLAN—9. Dental infections.
F. C. VALE—9. Dry clinic: Surgical and medical aspects of gastric and duodenal ulcer.

Wednesday

C. D. BROOKS and associates—9. Surgical clinic.
W. A. EVANS—9. Demonstration: Roentgenology of the gall bladder.
NORMAN ALLEN—9. Diagnosis of gastric malignancy.
F. C. KIDNER—9. Orthopedic operations.
L. J. HIRSCHMAN—9. Proctological operations.
A. C. HALL—9. Demonstration: Industrial surgery, fractures of os calcis.
E. C. DAVIDSON—9. Demonstration: Treatment of burns.
T. F. MULLEN—9. Demonstration: Dislocation of semilunar cartilage and fractures of scaphoid.
BYRON LONEY—9. Electrical burns.
G. B. CARPENTER—9. Treatment of carbon monoxide poisoning.
G. W. STOCKWELL—9. Demonstration: Ununited fractures.
W. A. EVANS, T. LEUCEUTIA, and C. K. HASLEY—9. Demonstration: Radiation and electric coagulation in malignant diseases.
E. G. MARTIN—9. Demonstration: Cases of dysentery treated by Bargen's method.
J. J. CORBETT—9. Demonstration: Management of acute proctological conditions.
H. P. CUSHMAN—9. Demonstration: Gynecological diagnostic methods.
L. W. HAYNES—9. Demonstration: Diagnosis of pregnancy.
W. T. SHANNON—9. Demonstration and comparison of methods in anæsthesia.

Thursday

MAX BALLIN and associates—9. Surgical clinic.
C. W. HALLIDAY and C. G. JENNINGS—9. Goiter clinic: Incidence of goiter, medical aspects of goiter.
GEORGE KAMPERMAN—9. Gynecological operations.
WARD SEELEY—9. Demonstration: Management of pelvic inflammatory disease.
F. H. COLE—9. Demonstration: Methods of diagnosis of ureteral obstruction.
W. K. Rexford—9. Demonstration: Bladder tumors.
R. A. MACARTHUR—9. Demonstration: Treatment of epididymitis.
H. C. SALTZSTEIN and TRIAN LEUCEUTIA—9. Cancer clinic.
A. D. LAFERTE—9. Open treatment of fractures.
F. C. KIDNER—9. Cases of enchondromata.
R. V. FUNSTON—9. Orthopedic results.
HAROLD HENDERSON—9. Puerperal sepsis.
O. C. FOSTER—9. Fetal mortality causes.
C. L. STRAITH—9. Oral surgery clinic, operations and demonstration of cases.
J. J. TOLAN—9. Dental infections.
F. C. VALE—9. Dry clinic: Surgical and medical aspects of gastric and duodenal ulcer.

Friday

C. D. BROOKS and associates—9. Surgical clinic.
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NORMAN ALLEN—9. Diagnosis of gastric malignancy.
F. C. KIDNER—9. Orthopedic operations.
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H. P. CUSHMAN—9. Demonstration: Gynecological diagnostic methods.
L. W. HAYNES—9. Demonstration: Diagnosis of pregnancy.
W. T. SHANNON—9. Demonstration and comparison of methods of anæsthesia.

PROVIDENCE HOSPITAL

Tuesday

EDWARD PANZNER—9. General surgery.
WILLIAM A. HARPER—9. Gynecology.
WILLIAM E. KEANE—9. Genito-urinary surgery.

Wednesday

WILLIAM J. SEYMOUR—9. General surgery.
JOHN BELL—9. Obstetrics.
CEDRIC P. SIBLEY—9. Genito-urinary surgery.
ALLEN MCDONALD—10:30. General surgery.

Thursday

RAYMOND ANDRIES and LOUIS MORAND—9. General surgery.
H. WELLINGTON YATES and ISAAC S. GELLERT—9. Gynecology.
JAMES MATHEWS—9. Orthopedics.
CHARLES J. JENTGEN—10:30. General surgery.

Friday

J. A. MACMILLAN—9. General surgery.
JOHN BELL—9. Obstetrics.
EDWARD DOWDLE—9. General surgery.
RALPH H. BOOKMEYER—10:30. General surgery.

HENRY FORD HOSPITAL

Tuesday

R. D. McCLURE and A. B. McGRAW—9. General surgical clinic, operations and demonstration of cases.
J. P. PRATT and H. M. NELSON—9. Gynecological clinic, operations and demonstration of cases.
JOHN K. ORMOND—9. Urological clinic, operations and demonstration of cases.
C. W. PEABODY—9. Orthopedic clinic, operations and demonstration of cases.

Wednesday

R. D. McCLURE and A. B. McGRAW—9. General surgical clinic, operations and demonstration of cases.
J. P. PRATT and H. M. NELSON—9. Gynecological clinic, operations and demonstration of cases.
C. W. Peabody—9. Orthopedic clinic, operations and demonstration of cases.
A. S. CRAWFORD—9. Neurosurgical clinic, operations and demonstration of cases.

Thursday

R. D. McCLURE and A. B. McGRAW—9. General surgical clinic, operations and demonstration of cases.
J. P. PRATT and H. M. NELSON—9. Gynecological clinic, operations and demonstration of cases.
JOHN K. ORMOND—9. Urological clinic, operations and demonstration of cases.
C. W. PEABODY—9. Orthopedic clinic, operations and demonstration of cases.

Friday

R. D. McCLURE and A. B. McGRAW—9. General surgical clinic, operations and demonstration of cases.
J. P. PRATT and H. M. NELSON—9. Gynecological clinic, operations and demonstration of cases.
C. W. PEABODY—9. Orthopedic clinic, operations and demonstration of cases.
D. S. CRAWFORD—9. Neurosurgical clinic, operations and demonstration of cases.

Demonstrations—Daily, 9 a. m.

R. S. SIDDALL and R. J. SISSON. Obstetrical clinic: incidence of late toxæmia of pregnancy and significance for subsequent pregnancy; ethylene anæsthesia in obstetrics, pathology of the placenta and umbilical cord; developmental anomalies of the fetus and other pathological specimens.

F. J. SLADEN, R. H. DURHAM, A. E. KOEHLER, R. L. JOHNSTON and associates. Demonstrations with exhibits: Graphic illustration of the organization of the hospital from the standpoint of the patient; the curriculum of the interne; critique of record methods with exposition of a new method; the pre-operative problem of hypertension to the surgeon, and after results; direct capillary studies; congenital deformities of the gall bladder.

F. R. MENAGH, S. J. JOYCE and associates. Demonstrations with exhibits. Etiology of angioneurotic œdema; dermatological lesions (lantern slides); relationship of Kahn test to clinical syphilis (Dr. Hartman).

J. G. MATEER, W. S. HENDERSON and associates. Demonstrations with exhibits. Clinical evaluation of cholecystography based on 1000 cases; method of preparation of patients for cholecystography; general method of gastro-intestinal survey; method of differentiation of cases of jaundice; pre-operative problem of pyloric obstruction.

D. P. FOSTER. Demonstrations with exhibits: Outpatient department studies in metabolism with examples; obesity in relation to blood pressure; use of glucose in treatment of nephritis; cases of diabetes and pregnancy.

T. J. HELDT, GROVES SMITH and associates. Demonstrations with exhibits: The aid of the neuropsychiatric service to the surgeon and obstetrician.

F. JANNEY SMITH, L. T. COLVIN and associates. Demonstrations with exhibits: Heart lesions produced by deep X-ray, experimental and clinical study (with Drs. Hartman, Doub and Bolliger); spontaneous hernia of lung through the chest wall; treatment of Stokes-Adams disease with barium chloride; clinic on lipiodol injections; diagnosis of lung abscess and artificial pneumothroax.

C. M. McCOLL, D. S. ARBUCKLE and associates. Demonstration: reception and handling of new patients in the outpatient department.

L. S. FALLIS, A. BOLLIGER and F. W. HARTMAN. Demonstration: Colloidal lead treatment of carcinoma, preparation and tissue reactions.

R. D. McCLURE and F. W. HARTMAN. Demonstration: Blood transfusion, methods and results, a plea for standardization.

H. P. DOUB. Demonstration: Radiological studies on thoracic tumors, development and response to deradiation.

F. W. HARTMAN, A. BOLLIGER and H. P. DOUB. Demonstration; Deep X-ray as an agent for the production of experimental visceral disease.

F. W. HARTMAN. Demonstration: Cytology of bone tumors.

C. Z. GARBER. Cytology of bone tumor.

CHILDREN'S HOSPITAL

Tuesday

FREDERICK C. KIDNER, ROBERT V. FUNSTON, and F. G. CURTIS—9. Orthopedic operations.
GROVER C. PENBERTHY and staff—9. General surgery of children.

Wednesday

FREDERICK C. KIDNER, ROBERT V. FUNSTON, and F. G. CURTIS—9. General surgery.
GROVER C. PENBERTHY and staff—9. Orthopedics.

Thursday

FREDERICK C. KIDNER, ROBERT V. FUNSTON and F. G. CURTIS—9. Orthopedic operations.
GROVER C. PENBERTHY and staff—9. General surgery.

Friday

FREDERICK C. KIDNER, ROBERT V. FUNSTON and F. G. CURTIS—9. General surgery.
GROVER C. PENBERTHY and staff—9. Orthopedics.

WOMAN'S HOSPITAL

Wednesday

C. H. JUDD—9. Gynecology.

Thursday

SUSANNE SANDERSON—9. Gynecology.

Friday

ARCHIBALD D. McALPINE—9. General surgery.
WYMAN BARRETT—9. General surgery.

ST. MARY'S HOSPITAL

Tuesday

WILLIAM J. CASSIDY—9. Tumor of cerebellum, toxic goiter, removal of foreign body in bronchus.
WALTER HACKETT—9. Resection of colon, cholecystectomy, appendectomy.
LEO DRETZKA—9. Decompression in skull fracture, vaginal repair, toxic goiter.
LANNES CONDIT—9. Fracture of femur (open reduction), amputation of foot, trephining in skull fracture.
ANDREW R. HACKETT—9. Pott's fracture, fracture of patella, open reduction of fracture of humerus.
ARMAND KERSTEN—9. Removal of tuberculous kidney, suprapubic prostatectomy, epididymectomy.
LORENZO ZIMMER—9. Watkins interposition operation for cystocele (vaginal repair), fibromyomata of uterus, hysterectomy.
JOHN CORBETT—9. Demonstration of local, sacral and spinal anæsthesia; hæmorrhoids, local; carcinoma of rectum, resection (Miles operation); prolapse of rectum.

Wednesday

WILLIAM J. CASSIDY—9. Appendectomy, duodenal ulcer (gastro-enterostomy), foreign body in knee joint (removal).
WALTER L. HACKETT—9. Waugh's replacement of ascending colon, Finney's gastroduodenostomy, myomectomy.
LEO DRETZKA—9. Cystocele and rectocele (repair), gastric ulcer (gastric resection), tumor of spine (removal).
LANNES CONDIT—9. Amputation of hip joint, cast for fracture of os calcis, fracture of patella.
ANDREW R. HACKETT—9. Cast of tibia, open reduction of fracture of humerus, appendectomy.
ARMAND KERSTEN—9. Cystoscopy, removal of tumor of scrotum, drainage of bladder.
WILLIAM A. REPP—9. Appendectomy, salpingostomy for sterility, amputation of cervix.
JOHN CORBETT—9. Colostomy for carcinoma of sigmoid, operation for pruritus ani.

Thursday

WILLIAM J. CASSIDY—9. Suture of ulnar nerve, brain abscess (drainage), excision of knee joint, resection of rib in empyema.
WALTER L. HACKETT—9. Thyroidectomy (adenoma), carcinoma of sigmoid, ovarian cyst.
LEO DRETZKA—9. Salpingectomy for pelvic inflammatory disease, carcinoma of tongue, resection of rectum for carcinoma (Miles operation).
LANNES CONDIT—9. Removal of foreign body from knee joint, cast for fractured femur, cast for fractured ribs.
ANDREW R. HACKETT—9. Removal of bone plates, foreign body in hand (removal), fractured tibia.
ARMAND KERSTEN—9. Stone in ureter, stone in bladder, removal of tuberculous kidney.
WILLIAM A. REPP—9. Hysterectomy, appendectomy, hæmorrhoids.
JOHN CORBETT—9. Hæmorrhoids under local anæsthesia, operation for imperforate anus, rectal fistula.

MICHIGAN MUTUAL HOSPITAL

G. C. PENBERTHY and DR. SMITH—9. Daily. General surgical operations and demonstration of cases. Repair of lacerations, amputations, reduction of fractures, care of ununited fractures, hernia cases.
Staff—9. Daily. Demonstration in physiotherapy department.

GRACE HOSPITAL

Tuesday

BRUCE ANDERSON—9. Hysterectomy for fibroid.
HERBERT W. HEWITT—9. Gastric surgery.
FRANK A. KELLY—9. Herniotomy, local anæsthesia.
HUGH A. HAGERTY—9. Fixation operation for procidentia uteri.
MILTON A. DARLING—9. Vaginal plastic.
FRANK E. CURTIN—9. Hibbs operation.
EDWIN C. HOFF—9. Cholecystectomy.
LEWIS E. DANIELS—9. Vaginal plastic.
HAROLD L. MORRIS—9. Operative procedures for bilateral renal calculi.
LEROY W. HULL—9. Scrotal surgery, epididymectomy, epididymotomy.

Wednesday

HAROLD K. SHAWAN—9. Thyroidectomy.
FRANK A. KELLY—9. Herniotomy, local anæsthesia.
ROBERT J. PALMER—9. Pylorectomy.
BRUCE ANDERSON—9. Vaginal plastic.
LEWIS E. DANIELS—9. Hysterectomy for carcinoma of cervix.
CHARLES S. KENNEDY—9. Gastric surgery.
WILLIAM A. HUDSON—9. Pneumonectomy.
MILTON A. DARLING—9. Demonstration of lipiodol injection of fallopian tubes.
HARRY W. PLAGGEMEYER—9. Prostatectomy.
GEORGE C. BURR—9. Cystoscopy, with local anæsthesia.

Thursday

HERBERT W. HEWITT—9. Cholecystectomy.
BRUCE ANDERSON—9. Abdominal hysterectomy for fibroid.
WILLIAM E. BLODGETT—9. Albee operation.
HAROLD K. SHAWAN—9. Thyroidectomy.
GEORGE P. MYERS—9. Open reduction with bone graft for fracture of femur.
HUGH A. HAGERTY—9. Bilateral salpingo-oophorectomy.
FRANK A. KELLY—9. Herniotomy.
L. W. HARTMAN—9. Amputation of leg at hip joint.
R. L. CUMMING—9. Tuberculosis of genito-urinary tract, nephrectomy, dermoid cyst of scrotum.

Friday

HAROLD K. SHAWAN—9. Thyroidectomy.
ROBERT J. PALMER—9. Herniotomy.
CHARLES S. KENNEDY—9. Removal of spinal cord tumor.
WILLIAM E. BLODGETT—9. Hibbs operation.
FRANK E. CURTIS—9. Talipes equinovarus.
EDWIN C. HOFF—9. Operation on gall bladder and ducts.
FRANK A. KELLY—9. Hernia, local anæsthesia.
GEORGE P. MEYERS—9. Resection of knee joint.
HARRY W. PLAGGEMEYER and R. L. CUMMINGS—9. Carcinoma of prostate, electrocoagulation of tumor.

ST. JOSEPH'S MERCY HOSPITAL

(Ann Arbor)

C. G. DARLING. General surgical operations and demonstration of cases.
I. D. LOREE. Genito-urinary operations and demonstration of cases.
C. L. WASHBURNE. Orthopedic operations and demonstration of cases.
H. H. CUMMINGS. Gynecological and obstetrical operations and demonstration of cases.
H. M. BEEBE. General surgical operations and demonstration of cases.

DETROIT RECEIVING HOSPITAL

Tuesday

H. K. SHAWAN and C. FREMONT VALE—9. General surgery.
H. F. DIBBLE—9. Gynecology.
H. W. PLAGGEMEYER and R. E. CUMMING—9. Urology.
W. E. BLODGETT—9. Orthopedics.
O. A. BRINES—9. Pathological conference.
PAUL EISEN—9. X-ray demonstration.

Wednesday

H. WELLINGTON YATES—9. Gynecology.
LEO DRETZKA and CHARLES B. LAKOFF—9. General surgery.
E. G. MARTIN—9. Proctology.
W. E. KEANE—9. Urology.
JAMES E. DAVIS—9. Pathological conference.
J. C. KENNING—9. X-ray demonstration.
ALEXANDER W. BLAIN—11. General surgery.

Thursday

W. J. SEYMOUR—9. General surgery.
A. D. LAFERTE and L. I. CONDIT—9. Bone and joint surgery, open reduction of fractures.
WARD F. SEELEY—9. Gynecology.
H. K. SHAWAN and C. FREMONT VALE—9. General surgery.
O. A. BRINES—9. Pathological conference.
PAUL EISEN—9. X-ray demonstration.

Friday

ANGUS MCLEAN—9. General surgery.
FRED H. COLE—9. Urology.
LEO DRETZKA and CHARLES B. LAKOFF—9. General surgery.
L. J. HIRSCHMAN and J. J. CORBETT—9. Proctology.
JAMES E. DAVIS—9. Pathological conference.
J. C. KENNING—9. X-ray demonstration.

JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

Tuesday

ALEXANDER W. BLAIN—9. Thyroidectomy for Graves' disease.
IRA G. DOWNER—10. Cholecystectomy and appendectomy.
LEO E. GRAJEWSKI—11. Bilateral epididymectomy, chronic epididymitis.
DAVID F. HERON—12. Oral surgery.

Wednesday

PAUL EISEN—9. X-ray demonstration, gastric ulcer.
ALEXANDER W. BLAIN—10. Gastric resection for gastric ulcer.
OSBORNE A. BRINES—11. Direct blood transfusion.
WEE K. LIM—12. Industrial surgery.

Thursday

IRA G. DOWNER—9. Gastro-enterostomy, duodenal ulcer.
ROY C. KINGSWOOD—10. Abdominal hysterectomy, fibroid of uterus.
OSBORNE A. BRINES—11. Direct blood transfusion.
HARVEY BLAIN—12. Oral surgery.

Friday

ALEXANDER W. BLAIN—9. Thyroidectomy, adenoma of the thyroid.
IRA G. DOWNER—10. Herniotomy, ventral hernia.
LEO E. GRAJEWSKI—11. Nephrectomy, pyonephrosis.
ROY C. KINGSWOOD—12. Vaginal repair, lacerations.

ST. JOSEPH'S MERCY HOSPITAL

Tuesday

GEORGE BAKER—9. Operations for mediastinal tumors and ventral hernia.
A. L. GIGNAC and B. B. BRUNKE—9. General surgical clinic.
DR. CUMMINGS—9. Urological clinic.

Wednesday

JOSEPH H. ANDRIES—9. General surgical clinic.
F. THOMPSON and C. J. FOLEY—9. Gynecological clinic, uterine suspension and lacerations.
F. ROBERTS—9. Urological clinic.

Thursday

WILLIAM HACKETT—9. Chronic appendicitis.
HUGH HARRISON—9. General surgical clinic.
H. MALEJAN—9. General surgical clinic.

Friday

E. C. BAUMGARTNER—9. Surgery of the gall bladder.
F. PURCELL—9. Orthopedic clinic.
E. LYNCH—9. General surgical clinic.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

ELDEN C. BAUMGARTEN and RUDOLPH L. PFEIFFER—9. Operations on gall bladder and female pelvis.

Wednesday

ALFRED H. WHITTAKER and JACOB MANTING—9. Demonstration of fracture cases and operative work on fractures.

Thursday

LESLIE HENDERSON and DANIEL LEITHAUSER—9. Cases of gastric and duodenal ulcer, operations.

Friday

ROBERT T. TAPERT and LAWRENCE N. HOST—9. Operations on thyroid and female pelvis.

HIGHLAND PARK GENERAL HOSPITAL

Tuesday

WILLIAM R. MCCLURE—9. Fracture clinic.

Wednesday

WILLIAM HUDSON—9. Surgery of non-tuberculous suppurative disease of the lung.

Thursday

FRANK C. WITTER—9. Gynecological and surgical clinic.

Friday

G. VAN AMBER BROWN—8. Plastic pelvic surgery, treatment of malignancy of uterine cervix.

SURGERY OF THE EYE, EAR, NOSE, THROAT, AND MOUTH

HARPER HOSPITAL

Tuesday

GEORGE FROTHINGHAM and associates—2. Eye clinic, operations, presentation of cases, glaucoma.
H. LEE SIMPSON—2. Ethmoid and sphenoid diagnosis; headache originating from nasal conditions.
JACOB WENDEL—2. Mastoid postoperative complications.
R. H. PINO and R. J. SISSON—2. Slit lamp technique and fundus examinations.
PARKER HEATH—2. Arteriosclerotic changes in the fundus.
W. A. DEFNET, E. D. KANAGA, and ARTHUR HALE—2. Diagnostic demonstrations.
WILLIAM EVANS—2. Exhibit of mastoid X-ray plates.

Wednesday

DON M. CAMPBELL, DUNCAN CAMPBELL and associates—2. Eye clinic, industrial diseases of the eye.
HERMON SANDERSON—2. Sinus disease—surgical and non-surgical treatment.
J. MILTON ROBB—2. Spreading osteomyelitis of the skull.
WILLIAM EVANS—2. Exhibit of mastoid X-ray plates.
F. L. RYERSON—2. Demonstration of fundus cases.
LEE LAIRD, C. C. WALKER, and R. E. ANSLOW—2. Diagnostic demonstrations.

Thursday

GEORGE FROTHINGHAM and associates—2. Eye clinic, operations, presentation of cases, glaucoma.
H. LEE SIMPSON—2. Ethmoid and sphenoid diagnosis, headache originating from nasal conditions.
JACOB WENDEL—2. Mastoid postoperative complications.
H. H. PINO and R. J. SISSON—2. Slit lamp technique and fundus examinations.
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F. L. RYERSON—2. Demonstration of fundus cases.
LEE LAIRD, C. C. WALKER, and R. E. ANSLOW—2. Diagnostic demonstrations.
WILLIAM EVANS—2. Exhibit of mastoid X-ray plates.

ST. JOSEPH'S MERCY HOSPITAL

Tuesday

EUGENE SMITH, JR.—2. Eye, ear, nose, and throat clinic.

Wednesday

THOMAS KEATING—2. Operations for trachoma; plastic surgery of the nose.

Thursday

WILLIAM BEERY—2. Eye, ear, nose, and throat clinic.

Friday

J. M. GRAFF—2. Eye, ear, nose, and throat clinic.

UNIVERSITY HOSPITAL

(Ann Arbor)

Tuesday

WALTER R. PARKER, GEORGE SLOCUM, and MALCOLM BOURNE—1:30. Eye operations: Cataract extractions, simple, combined, Knapp.
R. B. CANFIELD, A. C. FURSTENBURG, and J. E. CROUSHORE—1:30. Otolaryngological clinic: Diseases of larynx and bronchi, with special reference to treatment of malignant disease of the larynx.

Wednesday

WALTER R. PARKER, GEORGE SLOCUM, and MALCOLM BOURNE—1:30. Eye operations: Iridectomy, trephine, cyclodialysis, extirpation of lachrymal sac.
R. B. CANFIELD, A. C. FURSTENBURG, and J. E. CROUSHORE—1:30. Otolaryngological clinic: Diseases of the nose and accessory sinuses; observation of the treatment of atrophic rhinitis.

Thursday

WALTER R. PARKER, GEORGE SLOCUM, and MALCOLM BOURNE—1:30. Eye operations: Anterior sclerotomy, skin muscle operation for entropion, Hess operation for ptosis, enucleation with glass-ball implant.
R. B. CANFIELD, A. C. FURSTENBURG, and J. E. CROUSHORE—1:30 Otolaryngological clinic: Infections of the temporal bone, complications, with special reference to treatment of sinus thrombosis and septicæmia.

JEFFERSON CLINIC AND DIAGNOSTIC HOSPITAL

Tuesday

WILSON RANDOLPH—2. Chronic suppurative otitis media; radical mastoidectomy.
F. T. MUNSON—2. Ivory implanted in cases of ozæna.

Wednesday

F. T. MUNSON—2. Tonsillectomies under local anæsthesia.

Thursday

GEORGE RENAUD—2. Conservative methods in treatment of upper respiratory conditions.

Friday

WILSON RANDOLPH—2. Extirpation of nasolachrymal duct.

ST. JOSEPH'S MERCY MOSPITAL

(Ann Arbor)

GEORGE SLOCUM. Eye clinics, operations and demonstration of cases.
R. B. CANFIELD. Nose and throat clinics, operations and demonstration of cases.
D. W. MYERS—Eye, ear, nose and throat clinics, operations and demonstration of cases.

MICHIGAN MUTUAL HOSPITAL

HOWELL L. BEGLE—10, daily. Routine care of patients with injured eyes. Discussion of industrial problems relative to injury of the eyes.

GRACE HOSPITAL

Tuesday

VOSS HARRELL—2. Surgery of ethmoid.
RAY W. HUGHES—2. Surgery of maxillary sinus.
JOHN E. GLEASON—2. Plastic surgery of nose and face.

Wednesday

WILLIAM FOWLER—2. Tonsillectomy, Sluder method.
NEIL BENTLEY—2. Tonsillectomy, LaForce method.
CHARLES C. MCCLELLAND—2. Tonsillectomy, dissection, gas anæsthesia.

Thursday

CHARLES C. MCCLELLAND—2. Surgery of the mastoid.
EMIL AMBERG—2. Surgery of the mastoid.
L. E. GRANT—2. Surgery of ocular muscles.

Friday

FRED JOHNSON—2. Surgery of lachrymal sac.
NEIL BENTLEY—2. Tendon tucking and operation for squint.
JOHN E. GLEASON—2. Surgery of larynx.

DETROIT EYE, EAR, NOSE AND THROAT HOSPITAL

Tuesday

BURT R. SHURLY—2. Surgical removal of papillomata of the larynx; intubation, tracheotomy, mastoidectomy, thyroidectomy.

Wednesday

O. J. SHORE—2. Radiology of sinuses and mastoid.
C. B. LAKOFF—2. Surgery of the head.
DUNCAN A. CAMBELL—2. Mastoid surgery.

Thursday

C. B. GAINES—2. Demonstration of various methods of tonsillectomy.
F. L. RYERSON—2. Septum operations.
R. J. HARDSTAFF—2. Septum operations.

Friday

E. S. BULLOCK—2. Artificial pneumothorax in relation to surgery of the chest.
R. W. GILLMAN—2. Jequirity treatment of chronic trachoma.
W. A. DEFNET—2. Clinical demonstration.

ST. MARY'S HOSPITAL

Tuesday

WILSON RANDOLPH—2. Mastoidectomy. Enucleation of lachrymal sac.

Wednesday

EUCLIDE V. JOINVILLE—2. Tonsillectomy, snare method, general and local anæsthesia. Cataract, congenital, discission.
RAYMOND J. SISSON—2. Advancement and tenotomy.

Thursday

BEN. F. GLOWACKI—2. Diagnostic laryngoscopy. Maxillary antrum. Caldwell-Luc operation.

Friday

T. P. CLIFFORD—2. Submucous resection. Tonsillectomy and adenoidectomy.

HENRY FORD HOSPITAL

Tuesday

K. W. COSGRAVE and W. B. HUBBARD—2. Chemical burns of the eye with experimental study.
W. T. GARRETSON—2. Modification of the LaGrange operation in simple glaucoma.

Wednesday

E. L. WHITNEY and G. C. HARDIE—2. Some interesting toxic amblyopias with accompanying charts.
W. T. GARRETSON—2. Rib cartilage graft in the orbit (moving pictures).

Thursday

E. L. WHITNEY and H. P. DOUB—2. Diagnosis of polyp in the antrum by X-ray and verified by radical maxillary operation.
W. T. GARRETSON—2. Lipoma of the œsophagus.

Friday

W. T. GARRETSON—2. Treatment of laryngeal abductor paralysis.
E. L. WHITNEY and W. A. SCHAEGER—2. Interocular foreign bodies, their treatment, with a report of cases.

PROVIDENCE HOSPITAL

Tuesday

R. E. MERCER—2. Demonstration of Mercer's antrum tube. Bilateral abductor paralysis. Radical ethmoidectomy.

Wednesday

DONALD M. GRAHAM—2. Oral surgery.
WILLIS POTTER—2. Technique of radical ethmoid and sphenoid operations. Radical mastoid operation. Tonsillectomy under local anæsthesia.
ROBERT BEATTIE and RAY CONNOR—2. Eye-ground clinic.

Thursday

WILLIAM P. WOODWORTH—2. Submucous resection, Adenoidectomy under ethyl chloride.
ROBERT BEATTIE and RAY CONNOR—2. Eye-ground clinic.

Friday

A. O. BROWN—2. Tonsillectomy under local and general anæsthesia. Simple mastoidectomy.

CHILDREN'S HOSPITAL

Tuesday

HOWELL L. BEGLE and R. SISSON—2. Eye clinic; ward rounds; fundus examinations.
JACOB S. WENDEL—2. Mastoid complications.

Wednesday

R. SISSON—2. Eye operations.
WILLIAM S. GONNE—2. Mastoiditis in infants.

Thursday

DRS. WALKER and O'HORA—2. Eye clinic; ward rounds; fundus examinations.
DON M. HOWELL—2. Accessory sinus disease in children.

Friday

HOWELL L. BEGLE—2. Eye operations.
J. B. NORTON—2. Treatment of chronic otitis media in children.

HIGHLAND PARK HOSPITAL

Tuesday

DON COHOE—2. Operation: Muscle advancement for strabismus. Demonstration: Monocular exophthalmus, retinitis pigmentosa, coloboma of the choroid.

W. O. MERRILL—2. Needle operation for cataract.

Wednesday

E. E. POOS—2. Tonsillectomies under gas anæsthesia, demonstration of tuberculous eye lesions.

C. T. STUBBS—2. Submucous resection of the nasal septum.

Thursday

DON COHOE—2. Radical operation for maxillary antrum.

W. O. MERRILL—2. Tonsillectomies, modified Crowe method.

Friday

W. O. MERRILL—2. Radical mastoid operation.

DETROIT RECEIVING HOSPITAL

STAFF—Daily, 2. (a) Meeting in staff room for discussion of material to be presented in operating rooms. (b) Clinical, surgical and anatomical demonstrations in operating rooms as follows:

J. M. ROBB and DON M. HOWELL. Radical frontal sinus operations.

I. S. SCHEMBECK. Tonsillectomies, local and general anæsthesia.

C. F. MCCLINTOCK. Stellate cervical ganglionectomy.

JOHN M. CARTER. Mastoid drainage problems. X-ray and surgical demonstrations of tear sac.

WILLIAM S. SUMMERS. Slit lamp and Gullstrand ophthalmoscopic demonstrations.

RALPH H. PINO and HAROLD D. JUDD. Demonstrations: complete conjunctival flap in eye injuries; special eye dissections.

J. H. SHACKELFORD. Oral surgery. Fractures of the maxilla and mandible.

DON M. CAMPBELL. Otological operations and demonstration of cases.

EVANGELICAL DEACONESS HOSPITAL

Tuesday

CLIFFORD F. BRUNK—2. Tonsillotomies: Modified Sluder, general anæsthesia; dissection, local anæsthesia.

Wednesday

CLIFFORD F. BRUNK—2. Intranasal cases: Submucous resection of nasal septum; drainage and irrigation of antri.

Thursday

CLIFFORD F. BRUNK—2. Tonsillotomies: Modified Sluder, general anæsthesia; dissection, local anæsthesia.

Friday

CLIFFORD F. BRUNK—2. Eye clinic: Muscle operation; demonstration of plastic cases.

WOMAN'S HOSPITAL

JOHN M. CARTER—2. Tuesday. Tonsil clinic.

HOSPITAL STANDARDIZATION CONFERENCE

Monday, 10 a.m.—Orchestra Hall

Chairman's Address. W. W. CHIPMAN, M.D., Montreal, President.

Address. T. K. GRUBER, M.D., Superintendent, Detroit Receiving Hospital, and Chairman, Detroit Hospitals Council.

Introduction of Distinguished Guests.

Presentation of Tenth Annual Report of the Hospital Standardization Movement. FRANKLIN H. MARTIN, M.D., Director General, American College of Surgeons.

The Application of Hospital Standardization Principles to U. S. Veterans Hospitals (Illustrated). B. W. BLACK, M.D., Medical Director, United States Veterans Bureau, Washington.

The Right of a Hospital to Choose its Staff. JOHN A. LAPP, Chicago; Director, National Catholic Welfare Conference.

The Adjudicating Aspect of the Staff Conference. JUDGE HAROLD M. STEPHENS, Salt Lake City.

Hospital Charges and Costs. JOHN A. MCNAMARA, Chicago; Executive Editor, The Modern Hospital.

The Care of the Patient of Moderate Means. BERT W. CALDWELL, M.D., Superintendent, Gordon Keller Memorial Hospital, Tampa, Florida.

General Discussion. Opened by ROBERT JOLLY, Superintendent, Baptist Hospital, Houston, Texas, and President, American Protestant Hospital Association.

Monday, 2 p.m.—Orchestra Hall

The Art of Nursing. REV. C. B. MOULINIER, S. J., Milwaukee; President, Catholic Hospital Association.

Fundamental Training for Nurses. GEORGE W. KOSMAK, M.D., New York; Editor, The American Journal of Obstetrics and Gynecology.

Facts and Findings Pertaining to Nursing, Gleaned from a Survey of the Hospital and Private Duty Nursing Fields, from the Standpoint of the Patient, the Doctor, and the Nurse. MAY AYRES BURGESS, Ph.D., New York; Director of Study for the Committee on Grading of Schools of Nursing.

Round Table Conference on Nursing Problems. Topics to be discussed: Education Requirements; Nursing Curriculum; Group Nursing; Central Nurses' Registries; State Requirements; Cooperation Between the Medical and Nursing Professions, and other problems.

Tuesday, 9:30 a.m.—Statler Hotel

Louis J. McKenney, Chairman of Board of Trustees, Highland Park Hospital, Presiding

Basic Considerations in Selecting Trustees. STEWART HAMILTON, M.D., Director, Harper Hospital, Detroit.

What the Trustees Should Know About a Hospital, and How Best to Secure this Information. ROBERT IRWIN, Vice-President of Board of Trustees, Butterworth Hospital, Grand Rapids.

Functions of the Board of Trustees. C. H. MARR, Chairman of Board of Trustees, Wyandotte General Hospital.

Round Table Conference: Relation of the Board of Trustees. Conducted by W. L. BABCOCK, M.D., Director, Grace Hospital, Detroit.

(a) To the Superintendent. CHARLES F. NEERGAARD, New York, Trustee, Carson C. Peck Memorial Hospital, Brooklyn, and Hospital Consultant.

(b) To the Superintendent of Nurses. MARY C. WHEELER, R.N., Detroit; General Secretary, Michigan State Nurses' Association.

(c) To the Medical Staff. SAMUEL JACKSON, Tacoma; Chairman of Board of Trustees, Tacoma General Hospital.

General Discussion. NEWTON E. DAVIS, Chicago; Corresponding Secretary of the Board of Hospitals, Homes and Deaconess Work of the Methodist Episcopal Church; and A. C. GALBRAITH, Toronto; Superintendent, Western Hospital.

Tuesday, 2 p.m.—Statler Hotel

W. H. Conley, M.D., General Medical Superintendent, Department of Public Welfare, New York, Presiding

The Compilation of Statistics as a Guide to Medical Efficiency. CHARLES EATON PHILLIPS, M.D., Attending Surgeon, Los Angeles General Hospital.

Medicolegal Responsibilities of Hospitals. JUDGE HAROLD M. STEPHENS, Salt Lake City.

The Emergency Department in the Hospital (Illustrated). PHILLIP H. KREUSCHER, M.D., Chicago; Professor of Clinical Orthopedic Surgery, Loyola University School of Medicine.

Advantages of Autopsies. BOWMAN C. CROWELL, M.D., Chicago; Associate Director, American College of Surgeons, and Director of Clinical Research.

Means of Securing Autopsies. RALPH G. MILLS, M.D., Pathologist, Mayo Clinic, Rochester.

A Minimum Standard for Physical Therapy (Illustrated). JOHN S. COULTER, M.D., Chicago; Assistant Professor of Physical Therapy, Northwestern University Medical School.

General Discussion. Opened by A. G. BARRETT, M.D., West Baltimore; President, Medical Committee, West Baltimore General Hospital, and EDGAR A. BOCOCK, M.D., Denver; Superintendent, Colorado General Hospital.

Wednesday, 9:30 a.m.—Statler Hotel

George E. Frothingham, M.D., Chief of Department of Ophthalmology, Rhinology, and Otolaryngology, Harper Hospital, Detroit, Presiding.

Standardization of Special Departments for Eye, Ear, Nose and Throat Patients in General Hospitals.

Presentation of a Minimum Standard for General Hospitals Caring for Eye, Ear, Nose and Throat Patients. JOSEPH C. BECK, M.D., Chicago; Associate Professor of Otolaryngology, University of Illinois College of Medicine.

Discussion opened by JOHN D. COURTENAY, M.D., Ottawa; Ophthalmologist, Ottawa Civic Hospital.

Organization. THOMAS E. CARMODY, M.D., Denver; Professor of Oral Surgery and Rhinology, University of Denver Dental Department.

Personnel. W. W. PEARSON, M.D., Des Moines; Otolaryngologist, Congregational, Mercy and Lutheran Hospitals.

Discussion opened by E. M. SHANKLIN, M.D., Hammond, Indiana; Ophthalmologist, St. Margaret's Hospital.

Records. PERRY G. GOLDSMITH, M.D., Toronto; Professor of Otolaryngology, University of Toronto Faculty of Medicine.

Staff Conference. WALTER H. SNYDER, M.D., Toledo; Ophthalmologist, Flower Hospital.

Discussion opened by John C. MCREYNOLDS, M.D., Dallas, Texas; Ophthalmic and Aural Surgeon, St. Paul's Sanitarium.

Instruction of Nurses and Internes. AUSTIN A. HAYDEN, M.D., Chicago; Ophthalmologist and Otolaryngologist, St. Joseph's Hospital.

Wednesday—2 p.m.

Demonstrations in Hospital Planning and Construction, Equipment, Organization, Administration, and Procedures—Conducted by the Detroit and Ann Arbor Hospitals.

Thursday, 9:30 a.m.—Statler Hotel

Round Table Conference—Conducted by M. T. MACEACHERN, M.D., Chicago; Associate Director, American College of Surgeons, and Director of Hospital Activities. Topics: Everyday Problems of Hospitals—Factors Determining Hospital Efficiency; Factors Influencing Average Days' Stay of Patients in Hospitals; Ideal Organization of the Medical Staff in an Open Hospital; Staff Conference Procedure; Essential Requirements for Accurate and Complete Case Records; Measures to Insure Professional Efficiency; Minimum Standard for Maternity Service in General Hospitals; Status, Functions, and Relations of the Dietitian to the Hospital Administration; Standardization of Ward Supplies and Routine; Educational Publicity for Hospitals.

Thursday—2 p.m.

Demonstrations in Hospital Planning and Construction, Equipment, Organization, Administration, and Procedure—Conducted by the Detroit and Ann Arbor Hospitals.